



HamTrain's

Foundation Study Guide 2025

Helping you study for your UK
Foundation amateur radio licence



HamTrain's Foundation Study Guide 2025 Edition

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Hamilton's Foundation Study Guide 2023 Edition

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Introduction

Welcome to the HamTrain Foundation Study Guide, created by Essex Ham. This book is designed as a simple revision guide for those studying to pass the UK Amateur Radio Foundation Exam.

The Essex Ham "HamTrain" team has been working hard since 2015 to make it as easy as possible to get into amateur radio. At the time of writing, we've had over 14,000 enrol on one of our free Internet-based courses, and our training material is used by clubs and groups around the UK.

We've been asked by students for a simple guide covering the main exam syllabus points that they can carry with them for study on the move. Following this excellent suggestion, we first released this study guide in 2024, and based on feedback on the first release, we've released an updated 2025 version, in both paper and electronic format, as well as an audiobook version. We hope that people will use this, along with our unique course, to help to pass the Foundation exam and get started with amateur radio.

This is not intended to be a lengthy book discussing the hobby in-depth, nor is it intended as a book that goes into great detail about every aspect of the technical details of how things work. If that's what you're looking for, other books are available. Instead, this touches on each area of the RSGB's exam syllabus, highlighting all of the key facts that you need to either a) remember, or b) understand to confidently pass your exam.

All feedback is appreciated, so please contact us with your comments so that we can continue to make improvements and updates. You can send your feedback to bookfeedback@essexham.co.uk

If you find this guide useful, please consider rating it on Amazon to help others discover this guide.

Pete Sipple M0PSX

About Our Course

Our free online course typically runs twice a month (with a “fast track” option for those in a rush). The course is split into nine modules, which line up with the chapters of this book, and each module ends with a short quiz.

The course lets you study when it's suitable for you – no live lessons, and no need for a webcam. Each module also has a full video, so you can watch as we discuss the material and demonstrate how things work.

In the course, you'll be working in an online classroom with other students and have the option to ask questions of the tutor and chat with other students. At the end of the course, there's a mock test to see if you're ready to sit the actual exam. We've included one of our mocks at the back of this book, too.

hamtrain.co.uk
Supporting UK Ham Radio Training

Brought to you by Essex Ham

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Ham Train: The Amateur Radio Training Resource

We're passionate about amateur radio, and we want to make the hobby as easy to take part in as possible. That's why we've created the "Ham Train" website.

Who's HamTrain for?

- Newcomers** – We offer information on how to get started, free training material, plus our free online training course that's been taken by over 12,000 students!
- Tutors & Clubs** – Our constantly updated free training material includes PowerPoint slides, handouts and videos. Our online course can be used to supplement and support existing club training.
- Newly-licensed** – We have lots of information on how to get started once you have your licence. You can also join our free online club for updates on the hobby and a busy forum.

For Newcomers

Our most popular service is our free online Foundation Training Course, "Foundation Online" – This is aimed at those who prefer to study at their own pace via computer. Courses are short, easy-to-follow, and free. Take a look at the following short video to find out more about our course:

Foundation Online...
hamtrain.co.uk
Watch on YouTube

To sign up to our free course, which runs once a month, go to: Foundation Online – over 12,000 enrollments and counting!

Our online courses are FREE. There are no live lessons and you study at a time to suit you. Start dates:

- 15th
- 7th July
- 4th August
- 1st September

Courses run for 3 weeks, but if you have an upcoming exam booked and need to start now, we offer a "fast track" option.

You can now take your exam at home online. See online exams.

Interested in getting started?
Apply here

Essex Ham Newsletter:
Looking for general updates on amateur radio? Join our free newsletter:

enter email address
☐ I accept the privacy rules of this site
SIGN UP

Tutor's Newsletter:
Are you involved as a tutor / trainer? Subscribe to our newsletter:

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To find out more about the free Foundation Online course, and to book a place on the course, go to **www.hamtrain.co.uk**

1. Getting Started

If you're new to the world of amateur radio and looking to get started, you'll probably be aware that the entry-level way into the hobby is the UK's **Foundation licence**.

Many years ago, getting started with amateur radio meant taking months of evening classes and learning Morse code. That all changed some years ago, and things got even easier as a result of the 2020 Covid lockdown when the exam moved online. This allowed newcomers to be able to sit their exams at home, and not have to wait months for a local course and trek miles to their local amateur radio club.

To get on-air with amateur radio, you need to pass a 26-question multiple-choice exam, and after passing, you can get an amateur radio licence and callsign. From then on, you're free to explore this unique hobby and go where your interest takes you. You might fancy chatting with like-minded locals, talking around the world, sending text and images via satellite, experimenting with different types of wireless tech, making contacts with distant stations, or simply learning more about communications and how the technology we take for granted works.

To pass your Foundation exam, you'll need to study various aspects of the hobby, including getting a basic understanding of the technical side of amateur radio, learning the basics of transmitters and antennas, how radio signals can be sent around the world and how to stop your signals from causing interference. The exam also includes questions about the rules and regulations set out by the UK's radio regulator Ofcom, as well as how to operate on-air and make contact with the worldwide amateur radio community.

What is Amateur Radio?

Amateur Radio is for self-training and experimentation.

It is non-commercial (No business use or commercial advertising).

Amateur Radio is a recreational activity that promotes technical innovation, development of technical skills and international friendship.

The **Foundation Licence** is the first of three UK levels: **Foundation**, **Intermediate** and **Full**.

Getting Your Licence

To get your Foundation licence, you'll need to take a short exam, managed by the RSGB (the Radio Society of Great Britain).

By sitting the one-hour exam, consisting of 26 multiple-choice questions, you can get an Ofcom amateur radio licence and callsign, and get started in this unique hobby.

You can take your exam online, remotely monitored by a volunteer invigilator via a webcam, or you can take the exam in person at one of the amateur radio clubs around the UK.

Exam Material

For your exam, you're allowed to take just one piece of reference material, which is a 4-page exam booklet. This is issued by the RSGB, and we strongly advise you to download and print a copy of this booklet to help with your studies.

Download the 4-page exam booklet from: **www.sxham.uk/ex307**

2. Technical Basics

Before we dive into this chapter, it's only fair to give you a heads-up that, for many, Technical Basics is a challenging chapter, especially for this early on in your studies.

For those new to electronics or with no desire to take a radio apart and look inside, this section can be seen as a scary one. The good news is that, for the Foundation exam, this section only accounts for 3 marks, and with a pass mark of 19 out of 26, you can afford to get all of these questions wrong and still comfortably pass, so don't worry too much!

For those with an existing knowledge of electronics, this section is perhaps a little basic, leaving a few gaps. It's important to appreciate that Foundation is the first of 3 levels, and the intent within the RSGB appears to be that Technical Basics sets up core knowledge that will be built up at Intermediate and Full.

Whether you feel that all of this section is alien or a little too basic, please review the section, watch our online course videos if that helps, and please stick with it, as things covered in this section will all start to come together after a few more chapters of the material.

2.1 Key symbols and values

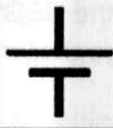
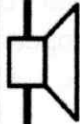
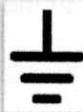
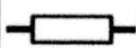
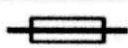
You'll need to know these for the Foundation exam:

	Symbol	Measured in	Units
Voltage (Potential Difference)	V	Volts	V
Current	I	Amps	A
Resistance	R	Ohms	Ω
Power	P	Watts	W
Frequency	f	Hertz	Hz
Wavelength	λ	Metres	m

Units	Meaning	Decimal	Prefix	Example
micro	one millionth	0.000001	μ	$1000\mu\text{V} = 1\text{ mV}$
milli	one thousandth	0.001	m	$1\text{mV} = 0.001\text{V}$
kilo	one thousand	1,000	k	$2000\text{W} = 2\text{kW}$
Mega	one million	1,000,000	M	$3\text{MHz} = 3,000,000\text{Hz}$
Giga	one thousand million	1,000,000,000	G	$2.4\text{GHz} = 2,400\text{MHz}$

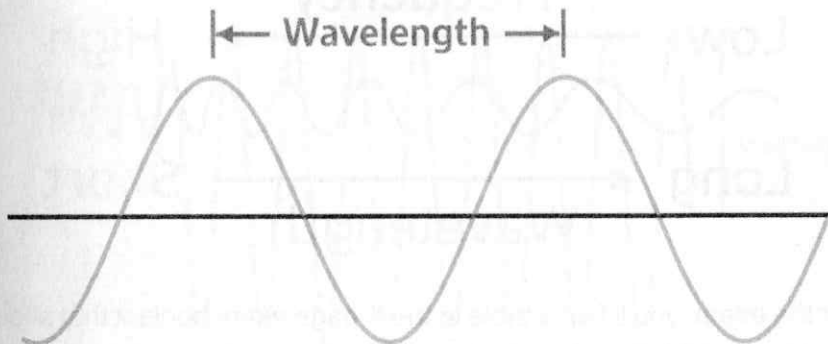
2.2 Symbols

Here are the symbols you'll need to remember and recognise for the Foundation exam:

					
Cell	Battery	Lamp (or bulb)	LED	Microphone	Speaker
					
Antenna	Earth	Resistor	Switch (s.p.s.t.)	Fuse	

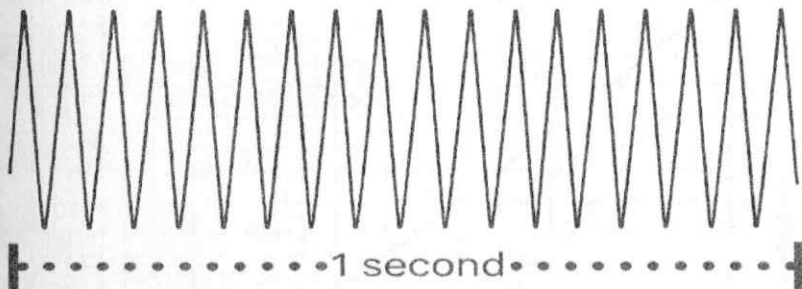
2.3 Frequency and Wavelength

Pictured here is a single radio wave. The length of the wave is measured from the top of the peak to the top of the next peak:



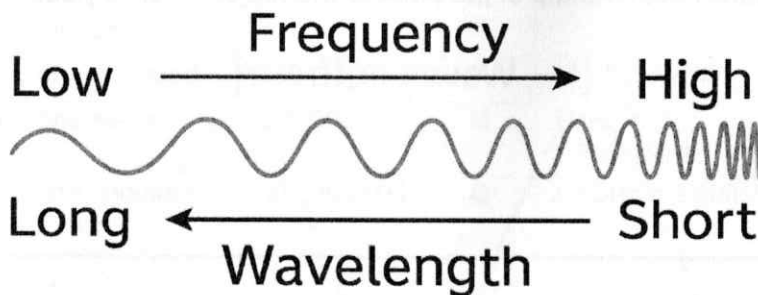
Frequency is the number of times that a radio wave happens per second. This is measured in Hertz.

Here is a graphic showing 17 cycles per second (17Hz):



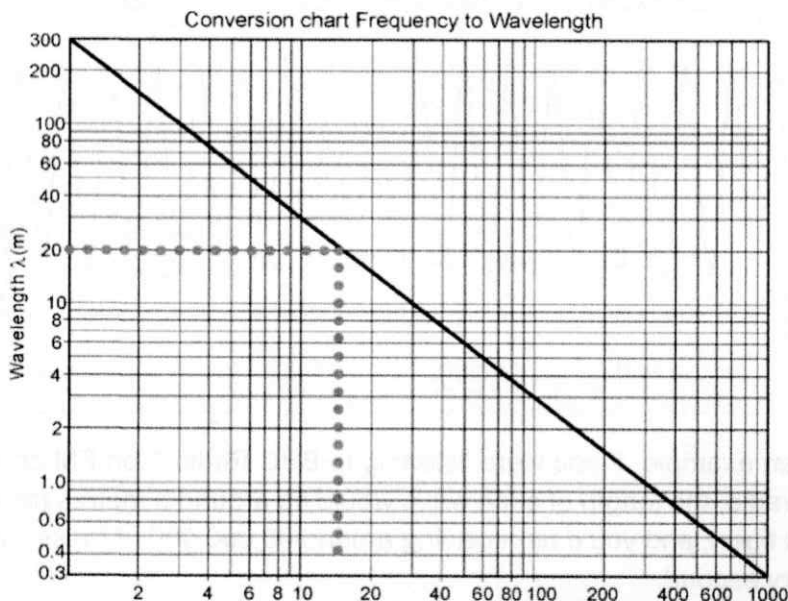
As an example, if you were listening to BBC Radio 1 on FM on your car radio, the length of each wave would be around 3 metres (as long as a tiger), and you'd be receiving around 98,000,000 of these waves every second.

You need to understand that as the frequency rises, the length of the wave reduces, as shown in this diagram:



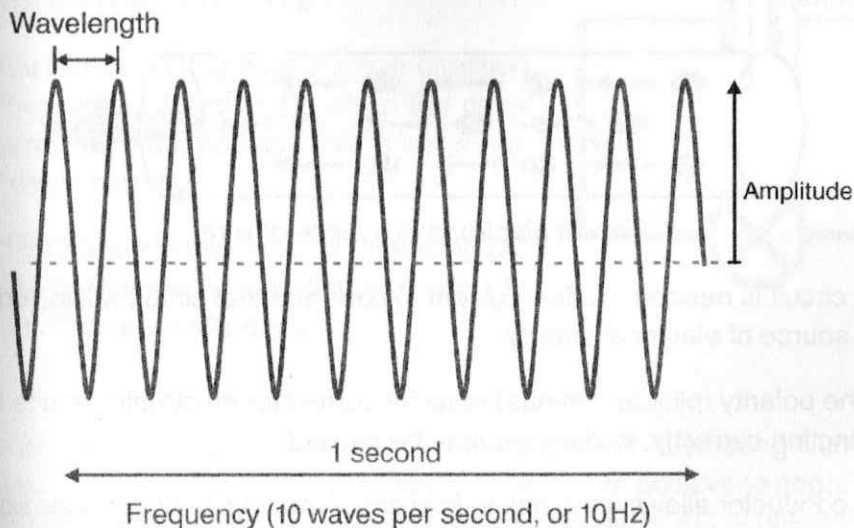
For the exam, you'll find a table in the 4-page exam booklet that allows you to convert between frequency and wavelength.

The following image shows how to use the converter to find the wavelength for 14MHz; simply follow the dotted line up from roughly 14MHz to the diagonal line, then follow over to the left, to see that the wavelength is 20 metres.



Frequency & Wavelength conversion table from the 4-page exam booklet

The following graphic shows wavelength, frequency (10 cycles per second), and also the wave's height (known as amplitude):



The frequency ranges are split into three “bands” that you’ll need to remember for the exam:

HF Band	High Frequency (<i>around the world comms</i>)	3MHz to 30MHz
VHF Band	Very High Frequency	30MHz to 300MHz
UHF Band	Ultra High Frequency	300MHz to 3,000MHz

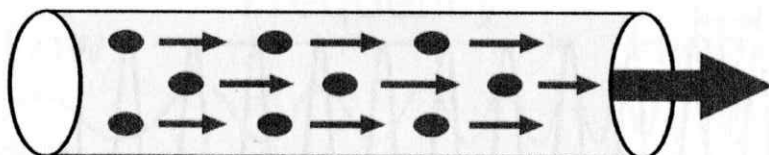
You’ll also need to be familiar with the following two terms:

RF stands for “Radio Frequency” (signals sent or received over radio).

AF stands for “Audio Frequency” (signals containing speech or something we can hear with our ears).

2.4 Circuits

The flow of electrons in a circuit is known as the current (measured in Amps).



Flow of electrons in a piece of wire

A circuit is needed to allow current to flow, and that circuit will include a source of electrical energy.

The polarity (plus and minus) must be correct for electronic circuits to function correctly, or damage may be caused.

A conductor allows electrons to flow easily, and an insulator does not.

- Conductors: Copper and brass are good conductors, as is carbon.
- Insulators: Plastics, rubber, glass and ceramics.

Be aware that current can flow across wet insulators.

2.5 Resistance

Resistance is the property of a material that opposes the flow of electricity.



A resistor

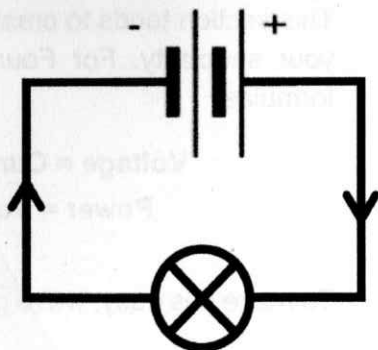
A current flowing through a resistor results in the conversion of electrical energy to heat energy in the resistor.

2.6 Direct and Alternating Current

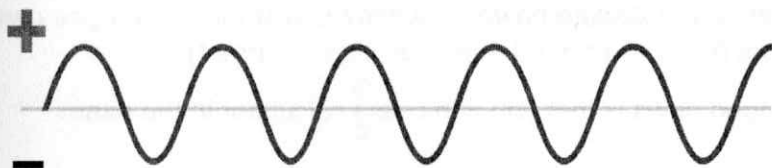
In the circuit shown here, you can see a battery powering a lamp.

Current is flowing from a single direction through the lamp and back to the other terminal in the battery. This is known as "direct current".

The battery in this circuit is producing DC Volts. Voltage is sometimes referred to as "*Potential Difference*".



The other form of current we might experience is Alternating Current (AC), where the current alternates in waves from positive to negative. Whilst batteries are DC, the UK mains voltage is AC – alternating around 50 times per second.



An alternating waveform

2.7 Batteries

A battery is a combination of cells (usually in series).

A battery provides electrical energy from stored chemical energy and has a Potential Difference across its terminals.

A rechargeable (secondary) battery has a reversible chemical process.

Any unwanted battery must be properly disposed of.

2.8 Formulas

This section tends to create the most worry, especially if maths is not your speciality. For Foundation, you need to remember just two formulas:

Voltage = Current multiplied by Resistance

Power = Voltage multiplied by Current

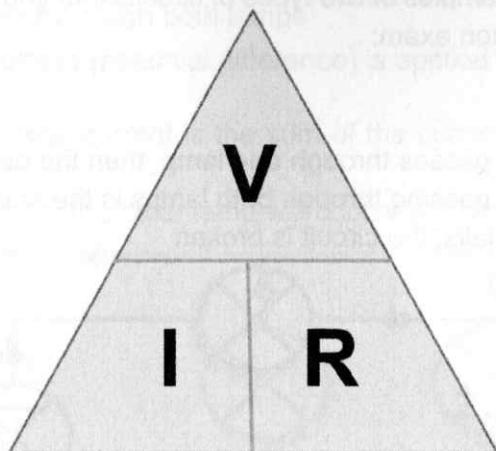
To make this easy, we're going to introduce you to the 'Triangle Trick'.

In the exam, you may be given two values and asked to calculate the third value. In a moment, we'll show you drawings of the two 'triangles'. The trick is to draw the appropriate triangle on a bit of blank paper and cover the missing one with your thumb. For example:

- Been given a voltage and a resistance (V and R) in an exam question? Then you need the current (I). Cover the I in the first triangle with your thumb, and you can see that the answer is V over R (voltage divided by resistance).
- Need to calculate power in watts? Cover the P, and you can see that the answer is V times I (voltage x current).

The good news is that you can use a calculator in the exam.

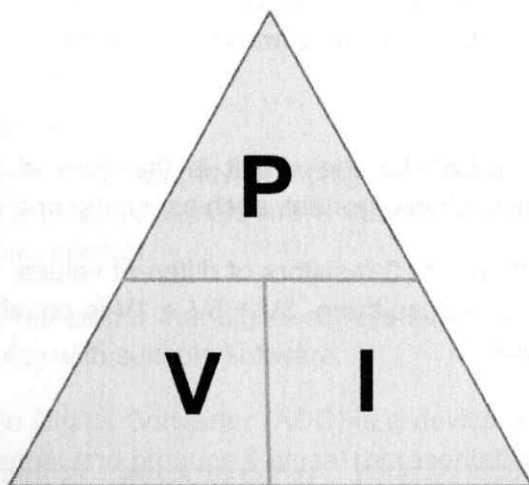
The two Foundation formula triangles



$$\text{Voltage} = I \times R$$

$$\text{Current} = V / R$$

$$\text{Resistance} = V / I$$



$$\text{Power} = V \times I$$

$$\text{Voltage} = P / I$$

$$\text{Current} = P / V$$

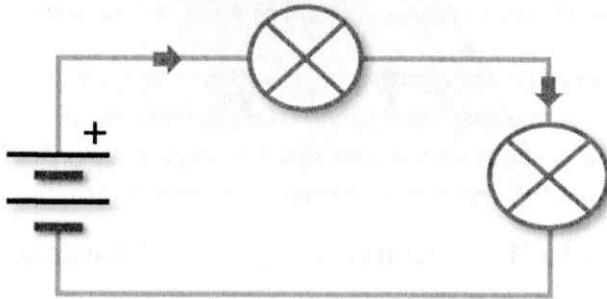
For a video with examples, go to www.sxham.uk/trainvids

2.9 Series and Parallel

Here we see examples of two types of circuits that you'll need to know for the Foundation exam:

“In Series”

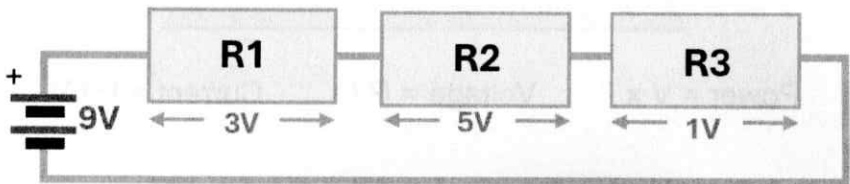
- The current passes through one lamp, then the other
- The current passing through both lamps is the same
- If one lamp fails, the circuit is broken



Circuit showing two lamps in series.

The voltage required for the circuit is the sum of the individual voltages across each component, such as a lamp or a resistor.

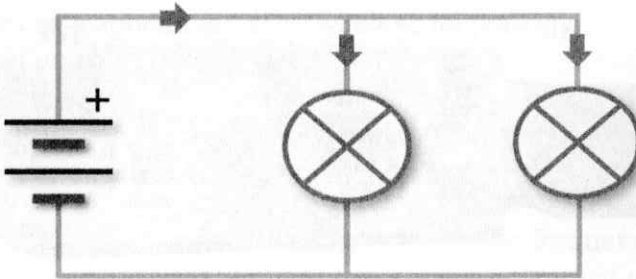
In this circuit, there are 3 resistors of different values. They all have different voltages across them. $3V + 5V + 1V$ is equal to the supply voltage of 9 volts.



Series circuit showing voltages across three resistors

"In Parallel"

- Current passes through both lamps
- The same voltage (potential difference) is applied across each of the lamps
- The circuit's total current is the sum of the current through each lamp
- If one lamp fails, the other lamp will continue to work



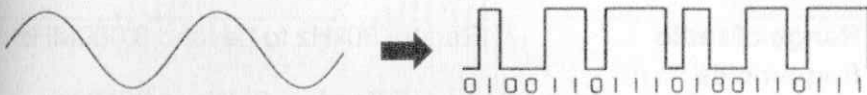
Circuit showing two lamps in parallel.

2.10 Digital signals

Analogue signals are constantly changing in amplitude, frequency or both. By contrast, digital signals are a stream of finite values at a specific sampling interval.

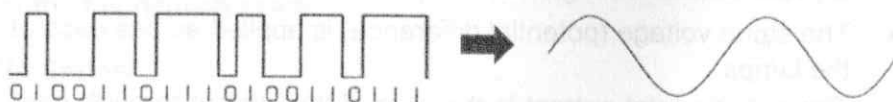
For the exam, remember that digital signals can be processed by a computing device with suitable software.

An Analogue to Digital Converter (ADC) is a device used to sample an analogue signal and produce a digital representation of it.

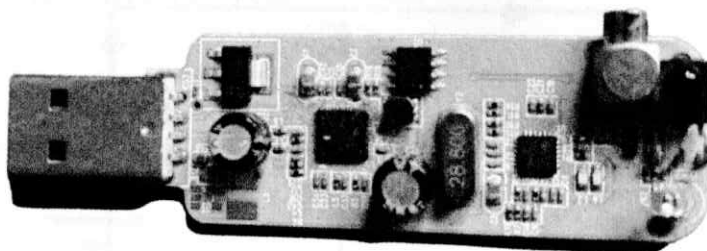


Analogue signal converted to digital

A Digital to Analogue Converter (DAC) is a device used to represent a digital signal in analogue format.



Digital signal converted to analogue



Inside a low-price USB digital software-defined radio receiver. We'll discuss this type of radio in the next chapter.

2.11 Important values

You may be asked one or more of the following in the exam:

Frequency of the UK mains (AC) supply	50Hz (alternating 50 times per second)
Range of frequencies for normal hearing	20Hz -15kHz
Range of frequencies for audio communication	300Hz – 3kHz
Range of radio frequencies	Range: 30kHz to beyond 3,000MHz • HF Band: 3MHz to 30MHz • VHF Band: 30MHz to 300MHz • UHF Band: 300MHz to 3,000MHz

3. Transmitters and Receivers

This section accounts for 3 marks in the Foundation exam.

A radio **transmitter** sends information from one place to another using electromagnetic radiation/wireless technology.

A radio **receiver** recovers information sent from one place to another using electromagnetic radiation/wireless technology.

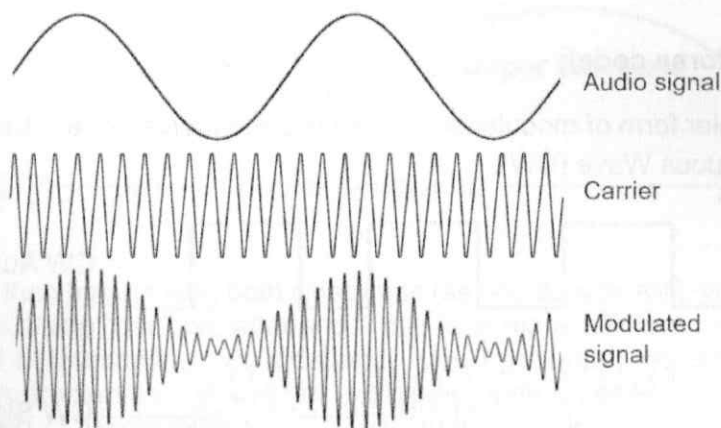
3.1 Modulation

Radio signals are made up of two parts: the audio (the message) and the required radio frequency (the carrier).

The process of adding a message to a radio frequency carrier is known as modulation. There are two common types of modulation – Amplitude Modulation and Frequency Modulation:

Amplitude Modulation (AM)

An AM signal combines the audio signal with a carrier on a set frequency to form a modulated signal. You will see that the resulting modulated signal increases and decreases in height (amplitude) depending on the volume of the audio signal:

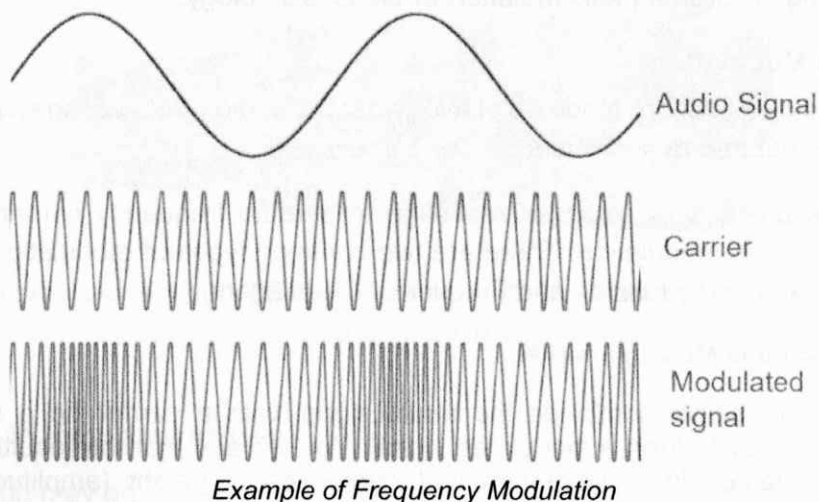


Example of Amplitude Modulation

Frequency Modulation (FM)

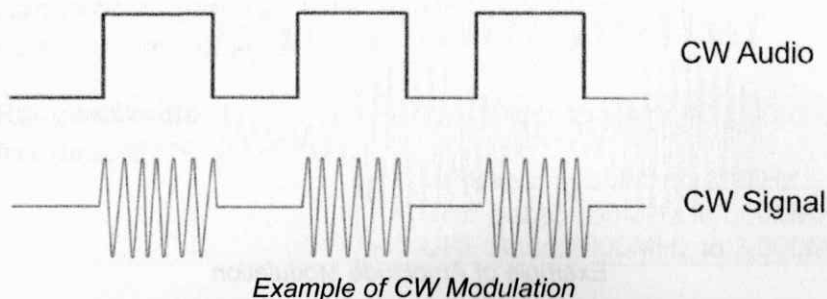
Again, the audio signal is combined with a carrier on a set frequency. This time, the height of the waves in the final radio signal matches the height of the carrier.

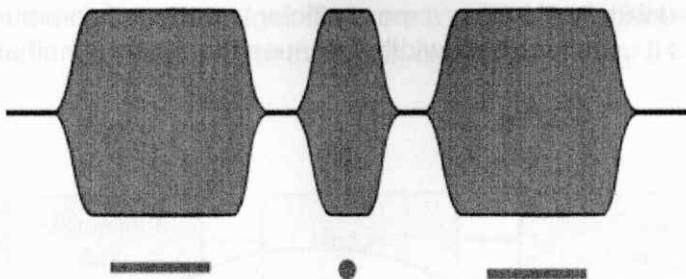
Note that, unlike AM, the height of the resulting signal is constant - i.e. the amplitude doesn't change. Instead, when the volume of the audio signal is louder, the waves are closer together (i.e. the frequency of waves per second increases).



CW (Morse code):

A simpler form of modulation is used to send Morse code – Using Continuous Wave (CW):



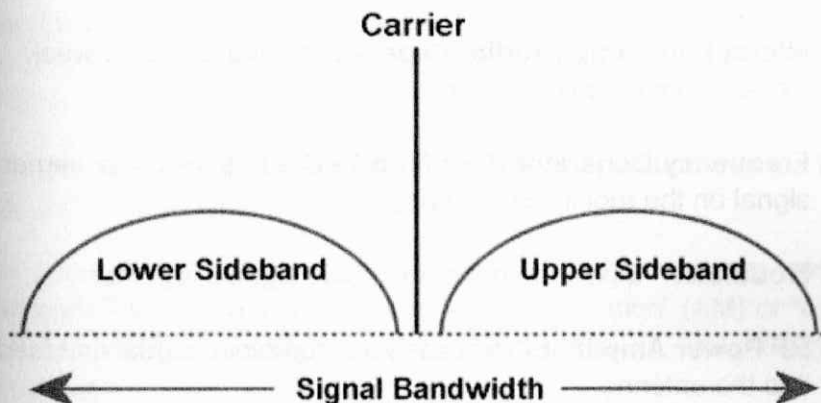


The letter "K" in Morse code

Single Sideband (SSB) Modulation:

For AM (amplitude-modulated) transmissions, when you mix the audio signals with the radio signals, it results in "sidebands" being created – these are just below and just above the carrier frequency. These are referred to as Lower and Upper Sidebands.

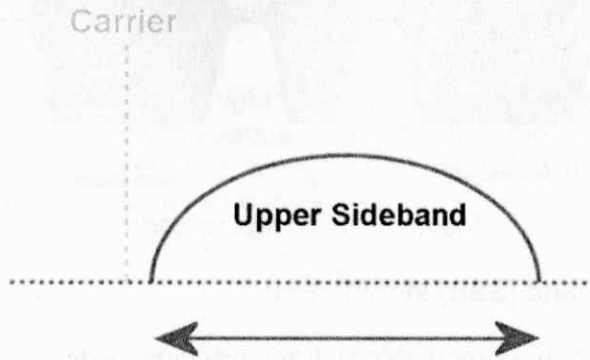
This is what an AM signal would look like - two sidebands on either side of the carrier:



Rather than transmitting both sidebands (as you do with AM), you can transmit using just one sideband - this is a more efficient method. Instead of transmitting two sidebands, you'll get better results using all your transmitted power for just one (either Lower or Upper Sideband - LSB or USB).

This is known as Single Sideband, or SSB, operation, and this method is commonly used on amateur radio bands.

Compared with AM, SSB is a more efficient method of communicating on HF, as it uses less bandwidth (because the signal is half as wide).



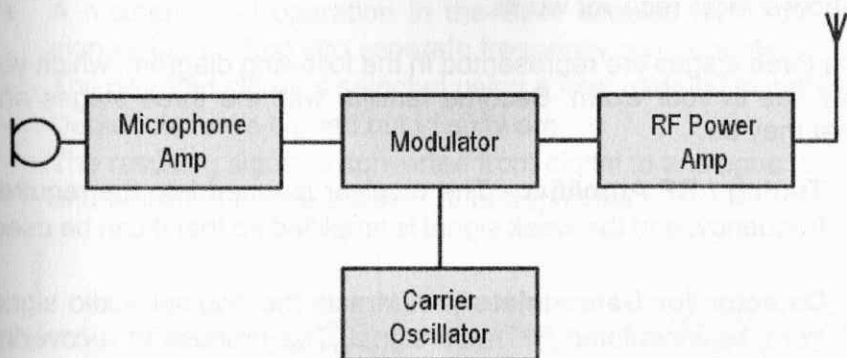
Example of a single sideband signal

3.2 Transmitters

A radio transmitter has four basic stages, as follows:

- **Microphone Amp (Audio Stage)** - Gets and amplifies weak signals from the microphone
- **Frequency Generator (Oscillator)** - Creates the radio 'carrier' signal on the required frequency
- **Modulator** - Mixes the radio and audio signals together
- **RF Power Amplifier** - Increases the combined signal and feeds it to the antenna

For the Foundation Exam, you will need to be able to identify the 4 boxes in the following transmitter block diagram:



Transmitter box diagram – a common exam question

In the transmitter box diagram, on the left, you have the microphone, which is amplified to a usable volume. This is the audio signal. At the bottom of the diagram, the Oscillator generates the required frequency. They are mixed together by the modulator to make the combined radio signal. They are then amplified and sent to the antenna.

Incorrect setting of the Oscillator can result in operation outside the amateur band and interference to other users.

The microphone volume (gain) must be set correctly to avoid distortion. Too loud a signal causes “over-modulation” (AM) or “over deviation (FM), possibly causing interference to neighbouring frequencies.

The RF power amplifier output must be connected to a correctly matched antenna to work properly. Use of the wrong antenna can result in damage to the transmitter.

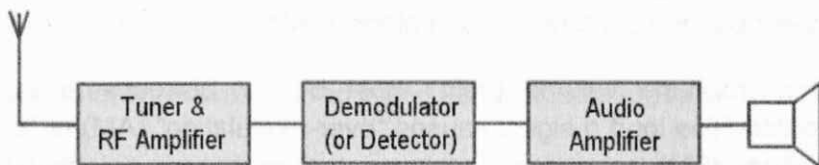
3.3 Receivers

For the Foundation exam, you are required to understand three parts of how a radio receiver works.

The three stages are represented in the following diagram, which you may see in your exam. Become familiar with the three stages and what they do.

- **Tuning / RF Amplifier** - The receiver is tuned into the required frequency, and the weak signal is amplified so that it can be used.
- **Detector (or Demodulator)** - Extracts the original audio signal from the modulated RF radio signal. The process of recovering the original audio is known as “demodulation”, and it separates the audio signal from the carrier. There are different types of detectors for each modulation type (e.g. FM, AM, SSB, etc).
- **Audio Amplifier** - This stage amplifies the recovered audio signal and feeds it to a loudspeaker or headphones.

For the Foundation exam, you will need to be able to identify the 3 boxes in the following receiver block diagram:



The Receiver box diagram

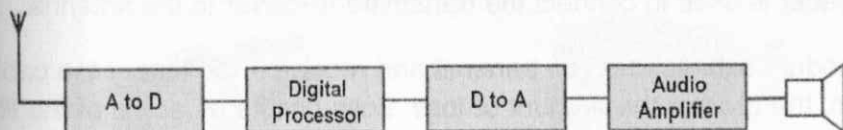
3.4 Software Defined Radios

A software-defined radio (SDR) differs from an analogue radio in that the work is done digitally using a computer processor. Here are the basics:

For the Foundation exam, you'll need to know the basics of how an SDR receiver and transmitter operate and be familiar with their block diagrams.

SDR Receiver

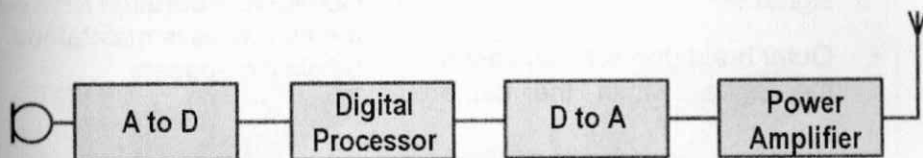
- Incoming signals are converted from analogue to digital (A-to-D).
- A mathematical operation in the SDR enables all of the radio signals to be sifted into separate frequency components.
- The required signal is selected using a filter (defined in software).
- Demodulation is carried out in software.
- The resulting signal is converted from digital to analogue (D-to-A) and amplified for the speaker or headphones.



SDR Receiver box diagram

SDR Transmitter

- Speech is converted from analogue to digital (A-to-D).
- The modulated radio signals are generated using software.
- The resulting signal is converted from digital to analogue (D-to-A), then amplified and fed to the antenna.



SDR Transmitter box diagram

4. Feeders and Antennas

This section accounts for 3 marks in the Foundation exam.

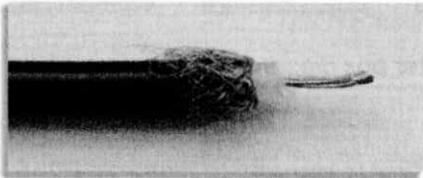
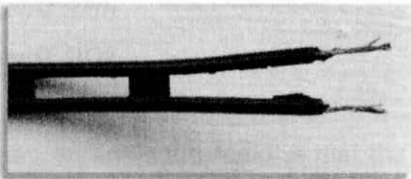
4.1 Feeder types

Feeder is used to connect the transmitter/receiver to the antenna.

Feeders exhibit “loss” on transmit and receive – the longer the cable run, the greater the amount of loss. Loss occurs as some of the RF energy is converted to heat.

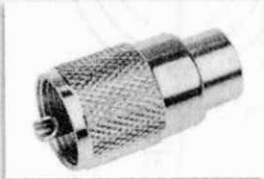
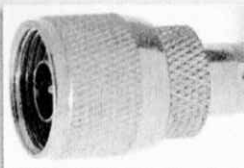
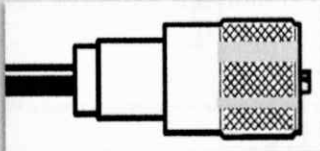
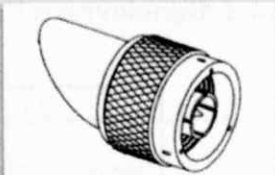
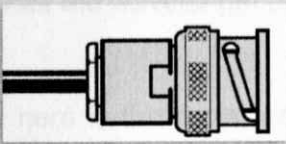
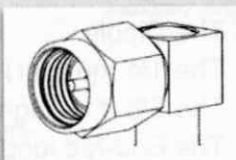
Feeder loss increases with frequency, so a thicker, low-loss feeder is required for VHF and UHF.

Here are the two types of feeders covered at Foundation:

Coaxial Cable	Twin Feeder (Ladder-line)
• Unbalanced • Widely used by amateurs • Inner conductor carries the signal • Outer braid (the screen) keeps the signal within the cable	• Balanced • Equal and opposite signals in the two wires • Constant separation between the two wires is maintained by plastic spacers
	

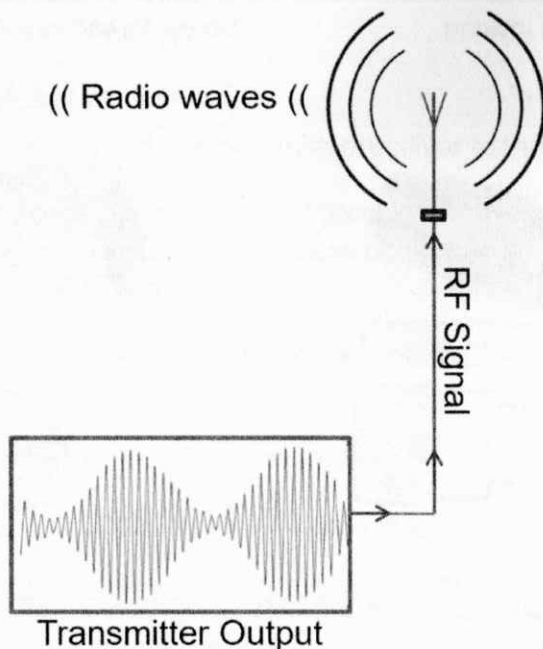
4.2 Cable connectors

There are four types of connectors that you will need to know about at Foundation:

PL259	N
Screw-thread locking	Screw-thread locking
Common for HF	Common for VHF/UHF
	
	
BNC	SMA
Bayonet locking	Screw-thread locking
We use 50Ω (not the 75Ω version which has a different type of pin)	Often found on handheld radios
	
	

4.3 Antennas

Antennas convert electrical signals into radio waves (when transmitting) and convert radio waves into electrical signals (when receiving).



A transmitter output connected by feeder to a radiating antenna

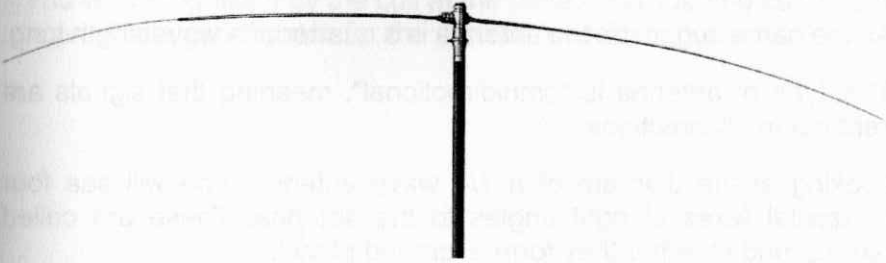
Antennas are designed for specific frequencies, and there are different sizes for different bands. In general, longer wavelengths (lower frequencies) need larger antennas.

Over the next few pages, we're going to look at the five different antenna types that you need to be familiar with for the Foundation exam:

- The Dipole
- The $\frac{1}{4}$ (quarter) wave
- The $\frac{5}{8}$ (five-eighth) wave
- The End-fed long wire
- The Yagi (beam antenna)

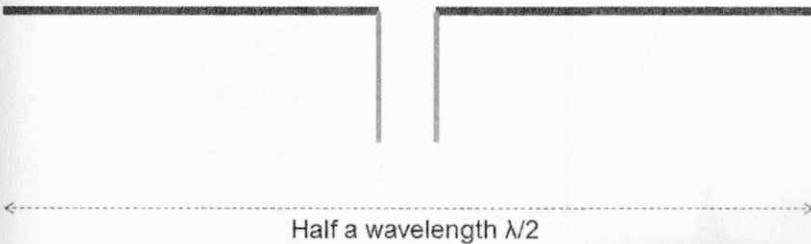
The Dipole

The dipole is a basic antenna, common in amateur radio.



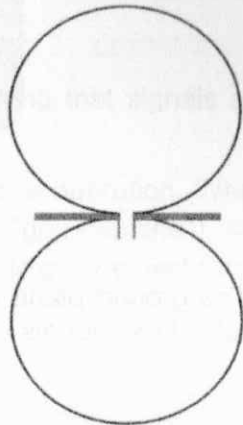
Example of a horizontal dipole antenna

The total length of a dipole is commonly **half a wavelength long**.



Example: To receive a station on 14.0MHz, you need to know the length of the wave. In the 4-page exam booklet, there is a conversion table. From this, you can see that the wavelength for 14MHz is 20 meters. In this example, the total length of the dipole will be 10 meters (half the wavelength of 20 meters).

Pictured here is the "polar pattern" for a half-wave dipole, with the circles showing how the signal radiates:



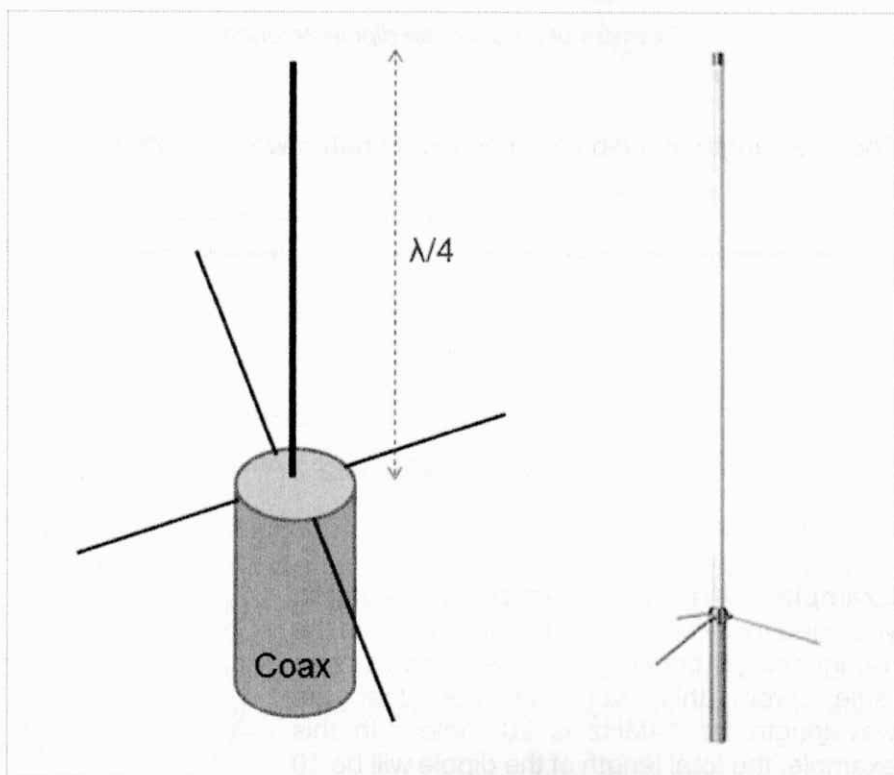
The $\frac{1}{4}$ Wave Ground Plane

This is a vertical antenna, commonly used for VHF and UHF frequencies.

As the name suggests, the antenna is a quarter of a wavelength long.

This type of antenna is "omnidirectional", meaning that signals are sent out in all directions.

Looking at the diagram of a $\frac{1}{4}$ wave antenna, you will see four horizontal wires at right angles to the antenna. These are called radials, and together they form a 'ground plane'.

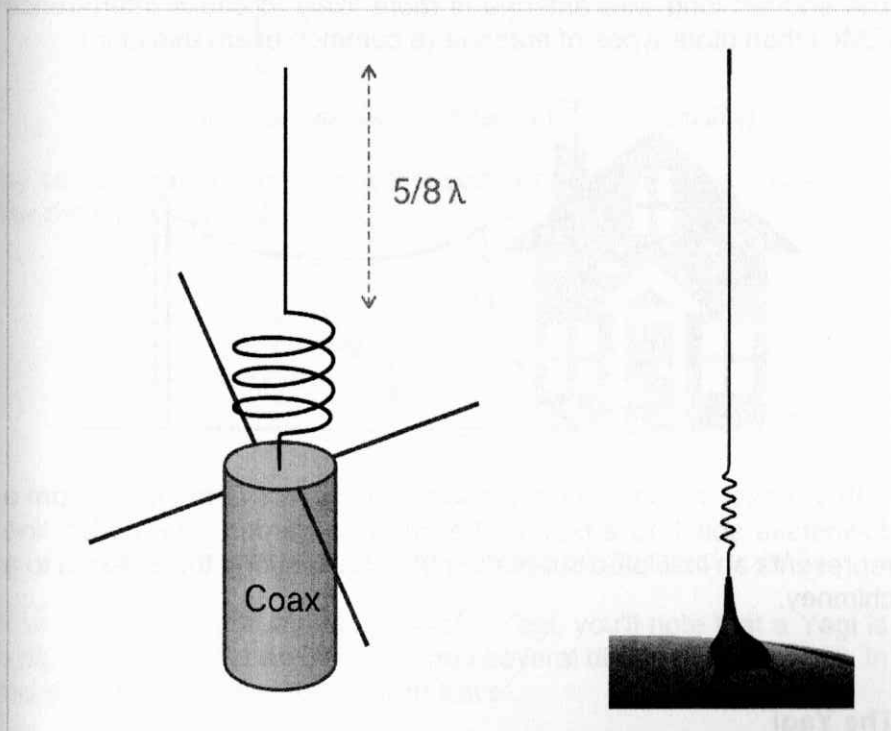


The ground plane acts as a mirror for the radio signals, helping to reflect the signals horizontally to increase the range.

The 5/8 Wave Ground Plane

This is another vertical antenna. It is $5/8$ of a wavelength long.

You will recognise it by the coil at the base. This 'loading coil' is there to provide a good match for the coaxial feeder.



This type of antenna is "omnidirectional", meaning that signals are sent out in all directions.

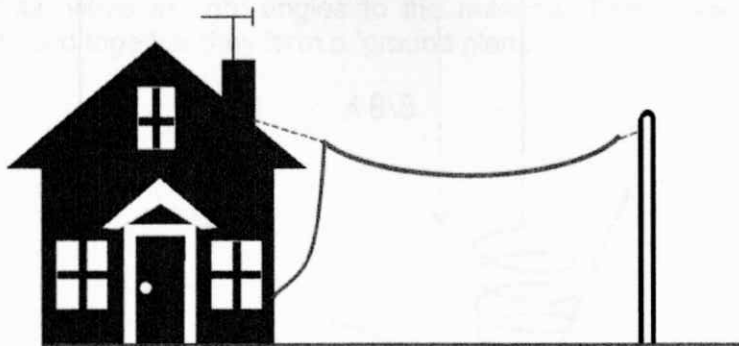
This antenna is often used for VHF / UHF mobile operation. When used on a metal car roof (that makes a good "groundplane"), this helps to send more of the energy out horizontally to get the best range when mobile.

The End Fed Long Wire

The end-fed long wire is a basic antenna - just a long piece of wire of a random length.

This is unlikely to be the correct length for any specific frequency, so it needs to be 'matched' - More on this later in this section.

The end-fed long wire antenna is more likely to cause interference (EMC) than other types of antenna (a common exam question).



In this image, the solid line represents a long-wire antenna fed from a downstairs shack to a pole at the end of a garden. The dotted line represents an insulated supporting guy line securing the antenna to a chimney.

The Yagi

The antennas we have mentioned so far are omnidirectional, meaning that they send radio signals out in multiple directions.

The **Yagi** is different in that it is a directional antenna. This type of antenna focuses the signal mainly in one direction and is pointed in the direction of the station you're trying to contact. They can also be used to receive distant signals.

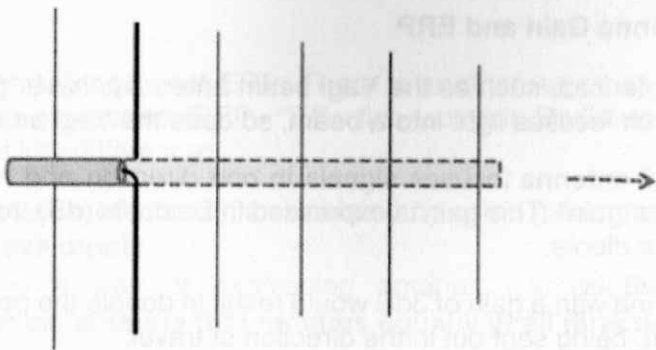
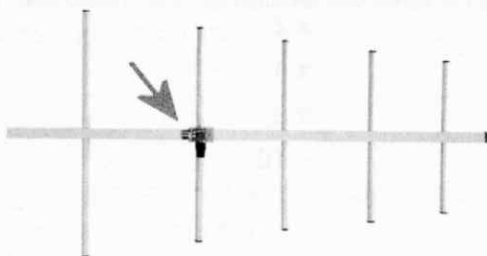


Diagram of a Yagi (beam) antenna when transmitting

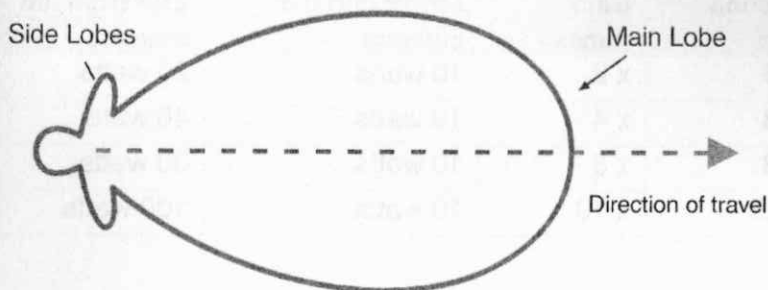
By sending radio signals in a focused beam, more energy is sent in the direction of travel.



Yagi beam antenna (the arrow indicates the "feed point")

If you look closely at the diagram of a Yagi, you'll note that a Yagi is a dipole with a reflector behind it, and several directors in front of it, in the direction you want to signal to travel.

Below is the polar pattern for the Yagi antenna:



Yagi polar pattern

4.4 Antenna Gain and ERP

Some antennas, such as the Yagi beam antennas, have "gain". Just like a torch focuses light into a beam, so does the Yagi antenna.

The **Yagi antenna** focuses signals in one direction and has what's known as "gain". This gain is expressed in Decibels (dB), relative to a half-wave dipole.

An antenna with a gain of 3dB would result in double the power being fed into it, being sent out in the direction of travel.

The following table, which is also in the 4-page exam booklet, gives the values that you are required to know at Foundation:

Antenna Gain	Multiplies the power by a factor of
3dB	x 2
6dB	x 4
9dB	x 8
10dB	x 10

Effective Radiated Power (ERP)

ERP is a measurement of how much power an antenna is radiating. It's calculated by multiplying the power fed into the antenna (in watts) by the antenna gain.

ERP (watts) = power fed to the antenna x the antenna gain

Antenna Gain	Gain (times)	Power into the antenna	ERP from the antenna
3dB	x 2	10 watts	20 watts
6dB	x 4	10 watts	40 watts
9dB	x 8	10 watts	80 watts
10dB	x 10	10 watts	100 watts

EIRP

We've been talking about ERP. There is another way that antenna gain can be expressed: EIRP - "Effective Isotropic Radiated Power." Here is the key difference:

- ERP (discussed above) is calculated by using gain **relative to a half-wave dipole**.
- EIRP is a way of expressing antenna gain **relative to a theoretical antenna that radiates equally in all directions**.

Antenna manufacturers often use EIRP as it shows a higher value than ERP, making the antenna gain look more appealing on paper.

10 watts EIRP would be the equivalent of 6.1 watts ERP. This number may be asked in the exam, as it's connected with something we cover later under "Licensing Conditions".

4.5 Polarisation

Antennas such as the dipole and the Yagi can be positioned to radiate their signals vertically or horizontally.

VHF and UHF signals will normally be received most effectively when the transmitter and the receiver have the same antenna polarisation (vertical or horizontal).

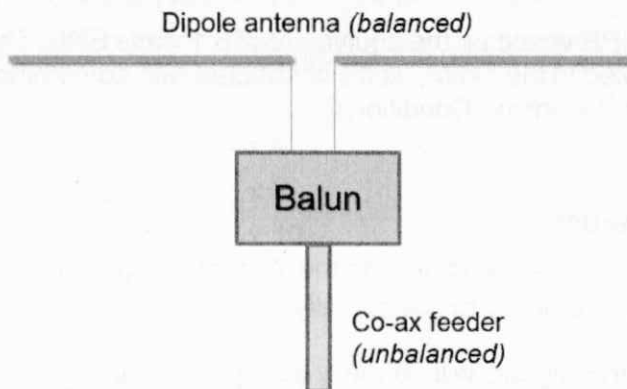
Antenna polarisation at HF is less important because the polarisation may change as a result of being refracted by the ionosphere – we cover this in more detail in the Propagation chapter.

4.6 Baluns

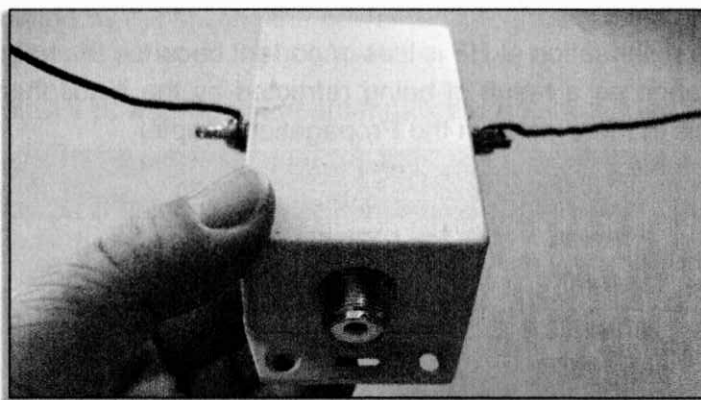
When connecting an unbalanced feeder to a balanced antenna, you need to connect the two using something called a **Balun**. The name is made up as follows: **BAL**anced to **UN**balanced = **BalUn**.

The Balun acts as an interface that separates the antenna system from the feeder cable so that the feeder doesn't "radiate" or become part of the antenna system.

Not using a Balun can result in interference issues, as without one, RF energy will radiate down the screen of the coaxial cable and get back into the shack - at high power, this can be a real problem.



Dipole antenna connected to coaxial feeder.



A close-up photo of a Balun for use on HF

4.7 Impedance

The connection point from the feeder to the antenna is called the "feed point".

An antenna has an 'impedance' (measured in Ohms). You'll learn more about impedance at Intermediate, but you'll need to be aware of the concept of impedance for the Foundation exam.

The impedance of an antenna depends on the dimensions of the antenna, how it's positioned and the wavelength of the applied signal.

Antennas are designed to be used on specific frequencies, and the feed point impedance of the antenna should ideally match the impedance of the feeder and the transmitter.

4.8 SWR (Standing Waves)

If the impedance of the antenna does not match that of the feeder, some energy will be reflected back from the antenna back down the feeder, creating 'Standing Waves' – the worse the match, the more energy gets reflected back to the transmitter.

An SWR (Standing Wave Ratio) meter tests whether there is a correct "match".

A Standing Wave Ratio of 1:1 is ideal (a good match). High SWR at the transmitter (much greater than a ratio of 2:1) indicates a feeder or antenna mismatch, which may damage the transmitter.

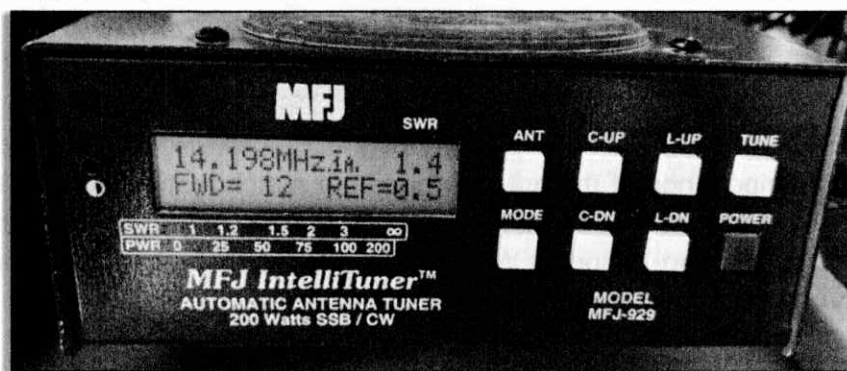


An SWR meter showing an acceptable SWR reading

4.9 Matching

If there is a mismatch between the transmitter and antenna impedance, you would correct this using an **AMU** (Antenna Matching Unit). This is sometimes referred to as an **ATU** (Antenna Tuning Unit).

- You can buy manual (tuned by dials) or automatic AMUs.
- These can correct the mismatch (reducing the SWR ratio) to ensure no damage to the transmitter.
- The AMU is commonly used when working 'multi-band' (using a single antenna for multiple bands).



An automatic Antenna Matching Unit, showing transmit frequency, SWR, forward power (in watts) and reflected power.

5. Propagation

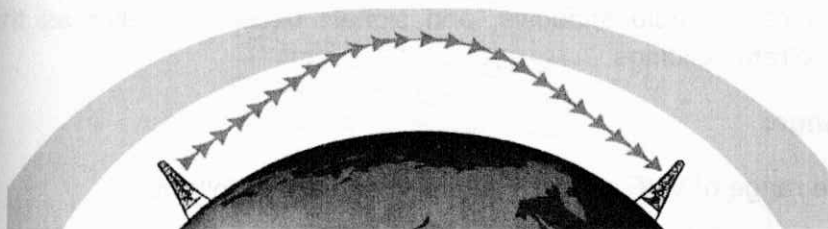
This section accounts for 2 marks in the Foundation exam.

Radio waves normally travel in straight lines, but they can be refracted, diffracted and reflected. Radio waves get weaker as they spread out.

5.1 The Ionosphere

The ionosphere comprises layers of ionised gases at heights between 70 and 400km above the Earth. The ionisation is caused mainly by ultraviolet rays from the sun.

On HF, most communication relies on the waves being refracted in the ionosphere. VHF and UHF signals normally pass through the ionosphere.



5.2 HF propagation

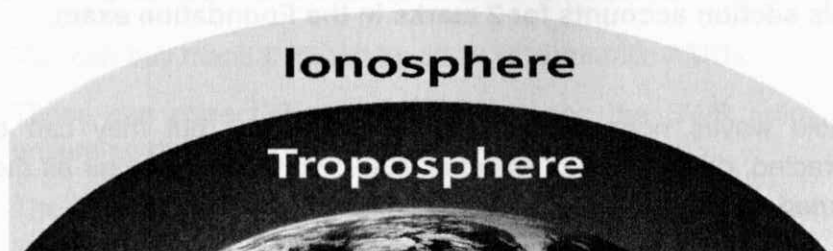
HF can provide worldwide propagation depending on how well the ionosphere refracts the waves back to the earth.

Propagation varies with frequency, the time of day, seasons of the year, and solar activity.

A band is said to be 'open' when it supports skywave propagation via the ionosphere.

5.3 VHF and UHF propagation

VHF and UHF signals normally take place within the troposphere situated below the ionosphere.



At VHF/UHF, the range decreases as frequency increases. In general, VHF/UHF waves have a range not much beyond line of sight.

The range achieved at VHF/UHF is dependent on antenna height, antenna gain, a clear path and transmitter power. Higher antennas are preferable to higher power as they improve both transmit and receive performance.

Outdoor antennas will perform better than indoor and loft antennas.

Hills cause radio shadows, and signals become weaker as they penetrate buildings.

Range:

The range of VHF and UHF signals can vary as follows:

Snow, hailstones and heavy rain can **reduce** the strength of signals at UHF and above. This is known as "attenuation".

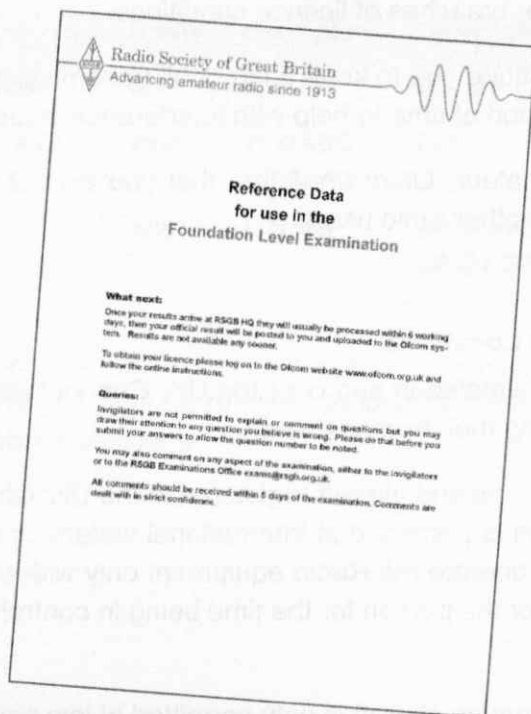
There are two conditions that can **increase** the range of VHF and UHF signals. These are covered in more detail at Intermediate, but they may come up in the Foundation exam:

- "Sporadic E" – One of the atmospheric layers is known as the "E" layer, and it behaves oddly in Summer, occasionally extending the range briefly.
- "Atmospheric ducting" – signals can get trapped in some layers and get carried along further than normal.

6. Licence Conditions

The Licence Condition section contains 6 marks in the Foundation exam.

This is the largest section of the exam, so it's worth making sure you study this section carefully. You will also need to have the 4-page exam booklet with you whilst studying this section.



Available from www.sxham.uk/ex307

As a reminder, the UK amateur radio licence is for self-training in radio communications and is of a non-commercial nature.

Business use and commercial advertising are not permitted.

6.1 Ofcom

Ofcom is the UK's TV and radio regulator. They issue our licences.

You must give immediate notice to Ofcom of any change to your name, main station address or mailing address.

You must confirm that the details shown on the licence are valid at least once every five years.

Ofcom has the right to inspect your station or ask you to modify your equipment, close down or restrict your operating. Ofcom can revoke your licence for breaches of licence conditions.

Ofcom may require you to keep a log of all transmissions made over a specified period of time to help with interference issues.

As a radio amateur, Ofcom requires that you do not cause undue interference to other radio users.

6.2 Operating Locations

Operation is permitted in and over the UK, Channel Islands and Isle of Man including their territorial seas.

Operation on ships and aircraft registered in the UK, Channel Islands and Isle of Man is permitted in international waters or airspace. The Licensee may operate the Radio equipment only with the agreement of the captain or the person for the time being in control of the ship or aircraft.

Transmitting from an aircraft is only permitted at low power and is not permitted on all bands. Check the Foundation Schedule in the 4-page exam booklet for restrictions that apply when airborne.

The Foundation licence does not permit use in other countries, their territorial waters or airspace. Other Administrations (regulators in foreign countries) do not routinely recognise the Foundation Licence, but some countries may make exceptions.

6.3 Callsigns

Callsigns are used to identify you on-air, and each callsign is unique to one person. They are assigned to you by Ofcom as part of your amateur radio licence.

The first part of the callsign shows the country and licence level, as shown in the table below.

The last 3 letters (e.g. "ABC") are unique to each person.

The UK amateur radio callsign structure is as follows:

Licence	Prefix	Example	Other (older) prefixes
FOUNDATION	M7	M7ABC	M3, M6
INTERMEDIATE	2xØ	2EØABC (England)	2x1
FULL	MØ	MØABC	GØ,G1,G2,G3,G4,G5, G6,G7,G8,M1,M5

For the Foundation exam, you will need to know the three different licence levels and may be required to identify the licence level from one of the above callsigns.

6.4 Regional Secondary Locators

These are optionally used to indicate which region an amateur radio station is transmitting from.

These are the regional secondary locators you need to remember for your Foundation exam:

Region	Identifier	Examples	
England	E	ME7ABC	2EØABC
Scotland	M	MMØABC	2MØABC
Wales	W	MW7ABC	2WØABC
Northern Ireland	I	MIØABC	2IØABC
Isle of Man *	D	MD7ABC	2DØABC
Jersey	J	MJØABC	2JØABC
Guernsey *	U	MU7ABC	2UØABC

** For the Isle of Man, "D" is for "Douglas" (the capital city). U is the second letter of Guernsey. No one seems to know why Scotland is "M", but for some, it helps to think that many common Scottish names begin with "Mc", e.g. McDonald, McIntyre, McKenzie, etc.*

Use of Regional Secondary Locators is optional, except for a 2x Intermediate callsign, where the regional letter is mandatory.

When operating from England, an 'E' can optionally be used with an M or G callsign, for example, "ME7ABC". This was only introduced in 2024 and is not very common, with the format M7ABC being far more common in England.

6.5 Callsign Suffixes:

Suffixes can optionally be used at the end of a callsign, typically to let others know about your type of operation.

You can use any suffix, as long as it is not offensive and does not obscure correct identification.

The four common suffixes are as follows:

Suffix	Meaning	Example
/M	Mobile: Car, pedestrian or inland waters	MM7ABC/M
/A	Alternate Postal Address, e.g. a hotel	2E0AAA/A
/P	Temporary: Field event with no postcode	M7PPP/P
/MM	Maritime Mobile (Vessel at sea)	M0QQQ/MM

When using a suffix on-air, you would typically say “MM7ABC stroke M” or “MM7ABC slash M”.

6.6 Using your callsign

The licence states that you must use your callsign “as frequently as practicable” so that your station is “clearly identifiable at all times” and in an “appropriate format consistent with the mode of operation”.

It's advisable to give your callsign when calling CQ (*looking for a general contact*), making contact with an amateur, when you change frequency, when you change mode, when there is a change of Regional Secondary Locator, or if there is a supervision change.

6.7 Supervision

As a licensed radio amateur, you can let other people transmit using your callsign under your “direct supervision”. This could be another radio amateur, or perhaps someone who wants to give amateur radio a try before they think about getting their own licence.

The Ofcom licence uses the term “using the Radio Equipment”, but in practice, this doesn’t refer to who actually owns the equipment – instead, it refers to how the transmitting station is being identified (i.e. the callsign that is being used on-air).

If you are letting someone else transmit with your equipment using your callsign under your direct supervision, the license states that you, as the license-holder:

- a) Must ensure all users are made aware of and comply with the terms, conditions and limitations of the Licence; and
- b) Remain responsible for the operation of the Radio Equipment and compliance with the terms, conditions and limitations of the Licence.

In certain circumstances (e.g. disaster, emergency, operation or related exercise), licenced amateurs may allow the equipment to be used by a member of a User Service to assist with communication.

What’s a User Service?

You don’t need to remember these for the exam, but they are: ‘Category 1’ emergency services and ‘Category 2’ responders, the British Red Cross, St John Ambulance, St Andrew’s Ambulance Association, the Royal Voluntary Service, the Salvation Army and any Government Department.

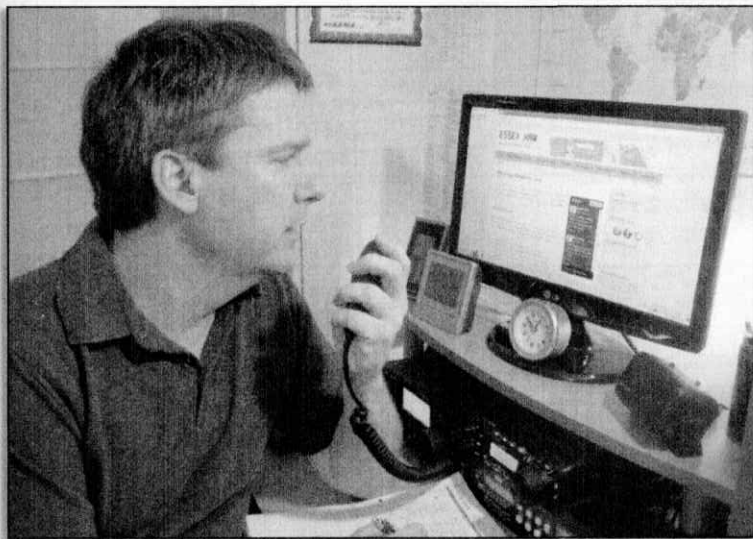
6.8 Messages

You can only send messages to other amateur radio stations.

Transmitting for general reception (or "broadcasting to anybody who may be listening") is not permitted, other than for CQ calls or 'nets'.

A 'Net' (short for network) refers to a conversation with three or more amateurs, as long as communication is first established separately with at least one amateur in any such group.

Encryption, or secret codes that obscure the meaning of a message, is not permitted, except under specific circumstances (such as if requested by a User Service, or for control of amateur radio satellites). Morse code is not a secret code, so it is permitted.



Nets are a popular way to keep in touch with local amateurs in your area, and many amateur radio clubs run regular nets. When you've got your licence, listen in to local nets and when you're ready, join in.

6.9 Parameters Table

You will be required to look up frequencies on the Foundation Schedule. This can be found on page 2 of the 4-page exam booklet, which you should print out and use for your studies. This can be taken into your exam and should be used when taking mock exams too. It is available from www.sxham.uk/ex307

We have a video exploring this booklet at www.sxham.uk/trainvids

Foundation Licence Parameters			
Frequency bands	Status of Amateur Service allocation under this licence	Status of Amateur Satellite Service allocation under this licence	Maximum Peak Envelope Power level in Watts (and dB relative to 1 Watt)
135.7-137.8 kHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	1W (0 dBW) ERP
1810-1830 kHz	Primary. Available on the basis of non-interference-other services outside the UK or Crown Dependencies.	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
1830-1850 kHz	Primary	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
1850-2000 kHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
3500-3800 kHz	Primary. Shared with other Services.	Not allocated	25 W (13.98 dBW)
7000-7100 kHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
7100-7200 kHz	Primary	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
10000-10150 kHz	Secondary	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
14000-14250 kHz	Primary	Primary	25 W (13.98 dBW)
14250-14350 kHz	Primary	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
18068-18168 kHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
21000-21450 kHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
24890-24990 kHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
28.0-29.7 MHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
50-51 MHz	Primary. Available on the basis of non-interference-other services outside the UK or Crown Dependencies.	Not allocated	25 W (13.98 dBW) 500 mW EIRP airborne
51-52 MHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	25 W (13.98 dBW)
70.0-70.5 MHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	25 W (13.98 dBW)
144-146 MHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
430-431 MHz	Secondary	Not allocated	25 W (13.98 dBW) ERP
431-432 MHz	Secondary. Not available for use within 100km radius of Charing Cross, London (51°30'30"N, 00°07'24"W).	Not allocated	25 W (13.98 dBW) ERP
432-435 MHz	Secondary	Not allocated	25 W (13.98 dBW)
435-438 MHz	Secondary	Secondary	25 W (13.98 dBW)
438-440 MHz	Secondary	Not allocated	25 W (13.98 dBW)
2400-2450 MHz	Secondary. Users must accept interference from ISM users.	Secondary. Users must accept interference from ISM users.	2 W (3 dBW)
5650-5670 MHz	Secondary	Secondary. Earth-space only	2 W (3 dBW)
5670-5680 MHz	Secondary	Not allocated	2 W (3 dBW)
5755-5765 MHz	Secondary. Users must accept interference from ISM users.	Not allocated	2 W (3 dBW)
5820-5830 MHz	Secondary. Users must accept interference from ISM users.	Not allocated	2 W (3 dBW)
10.000-10.125 GHz	Secondary	Not allocated	1 W (0 dBW)
10.225-10.450 GHz	Secondary	Not allocated	1 W (0 dBW)
10.450-10.475 GHz	Secondary	Secondary	1 W (0 dBW)
10.475-10.500 GHz	Not allocated	Secondary	1 W (0 dBW)

Example only - due to print size and copyright restrictions, we cannot include the full table in this guide.

Column 1: The frequencies available at Foundation

Column 2: "Primary" means that radio amateurs are the main users. "Secondary" indicates that another service is the "Primary" user and that the Primary user allows radio amateurs to use the frequencies.

Column 3: Whether each frequency range can be used for amateur radio satellite use (also with Primary and Secondary allocation listed)

Column 4: The maximum allowed transmit power.

50-51 MHz	Primary. Available on the basis of non-interference-other services outside the UK or Crown Dependencies.	Not allocated	25 W (13.98 dBW)
51-52 MHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	25 W (13.98 dBW)
70.0-70.5 MHz	Secondary. Available on the basis of non-interference-other services.	Not allocated	25 W (13.98 dBW)
144-146 MHz	Primary	Primary	25 W (13.98 dBW) 500 mW EIRP airborne
430-431 MHz	Secondary	Not allocated	25 W (13.98 dBW) ERP
431-432 MHz	Secondary. Not available for use within 100km radius of Charing Cross, London (51°30'30"N, 00°07'24"W).	Not allocated	25 W (13.98 dBW) ERP
432-435 MHz	Secondary	Not allocated	25 W (13.98 dBW)

Things to look out for on the Foundation Parameters table include:

- Some frequencies, such as 430-432MHz, have a maximum power limit in ERP
- 431-432MHz cannot be used within a 100km radius of London's Charing Cross
- Frequencies of 2400MHz and above have low power limits
- 135.7-137.8kHz are low power and with an ERP restriction

6.10 EMF rules

The licence requires that our equipment must not expose the public to EMF (Electromagnetic fields) over agreed limits.

This applies to transmitted power levels over 10 Watts EIRP (radiated power relative to a theoretical antenna), which is calculated as 6.1 Watts ERP (effective radiated power). We discuss ERP and EIRP under "Feeders and Antennas", but remember these two numbers for your exam.

"The public" includes neighbours, visitors, family members, as well as people at field events.

All amateurs are required to complete an assessment and keep a record of the assessment that Ofcom may ask to see.

- If the assessment shows a potential risk, appropriate steps must be taken to ensure transmissions are kept below the limits.
- If there is no further action required, the reason must be stated (e.g. "Power levels are below the threshold").

How do I complete an EMF assessment?

The exam doesn't ask you to go into any detail about how to complete an assessment, but you would typically use the EMF Calculator that has been created by the RSGB. You put details about your antenna and power, and it produces an assessment showing safe distances. We have a video on how to complete an assessment. See www.sxham.uk/emf

7. EMC

This section accounts for 3 marks in the Foundation exam.

Electromagnetic compatibility (EMC) is the avoidance of interference between various pieces of electronic equipment.

"Immunity" is the ability of any piece of equipment to function correctly in the presence of strong RF signals.

7.1 Causes of Interference

Transmitters can cause interference to nearby electronic and radio equipment. Receivers can also suffer from interference from local and other sources.

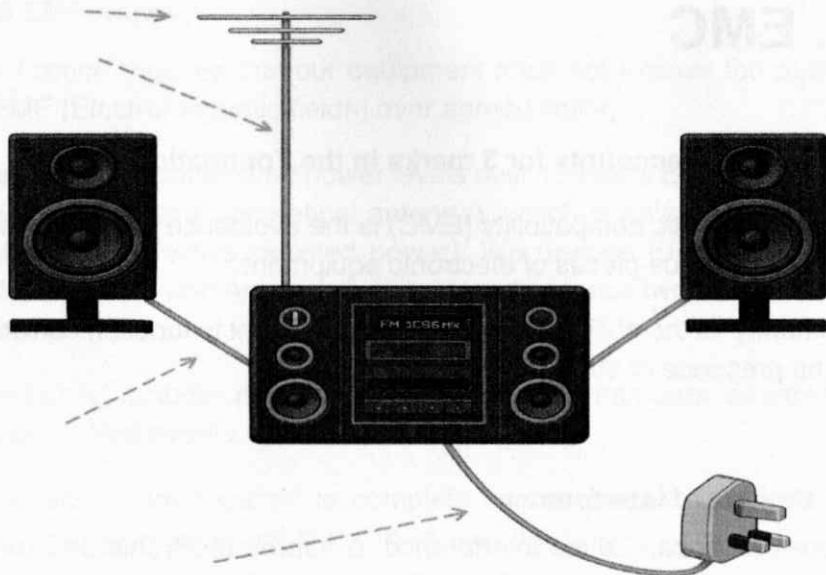
The more power a station runs, the more likely it is to cause interference.

Some types of transmission are more likely to cause interference to radio, television and telephones than others.

AM and SSB modes are the most likely types of transmission to cause problems. FM and some of the HF data modes are least likely to cause problems (for the exam, remember "Friendly Modulation").

Interference can occur due to nearby radio transmissions being conveyed to the affected equipment through:

- the home's mains wiring,
- TV aerial leads,
- speaker leads,
- telephone wiring and,
- by direct pick-up in the equipment's internal circuitry (particularly at VHF/UHF frequencies).



Possible points of entry for RF interference

7.2 Reducing interference

The immunity of most types of equipment can be increased by fitting suitable filters or 'chokes' in mains or antenna leads.

Filters should be fitted as close to the affected device as possible.

Interference problems can be minimised by siting antennas as far away from houses as possible, as high as possible, and using balanced antennas at HF.

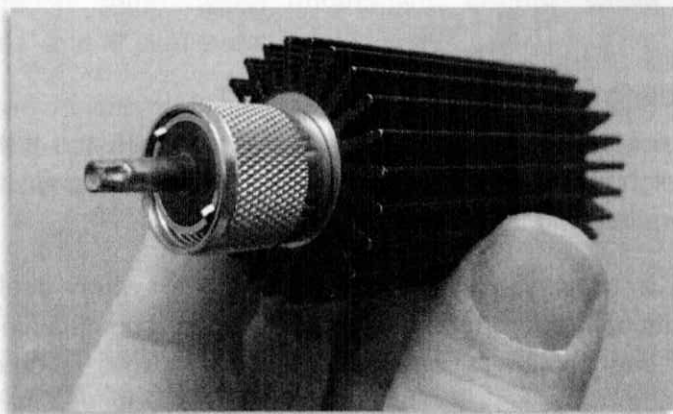
At HF, horizontal dipoles are less likely to be a problem than other antenna types. End-fed wires can present significant EMC problems.

Information on avoiding interference can be obtained from the RSGB's EMC team, from experienced radio amateurs online or at local clubs.

7.3 Dummy loads

A dummy load is a screened resistor of the correct value and with a suitable power rating. These can be connected to the output of a transmitter instead of an antenna, to allow the transmitter to be operated without radiating a signal.

Transmitting into a dummy load is a good test for any unwanted RF being conducted out of the transmitter along its power supply leads, any connected interface leads and into the mains.



A dummy load

7.4 RF earths

The function of the RF earth connection in an amateur station is to provide a path to ground to minimise RF currents entering the mains earth system and causing interference to other electronic equipment.

7.5 EMC in cars

It is the vehicle owner's responsibility to ensure that any radio installation is compatible with the vehicle's electrical and management systems and does not affect vehicle safety.

Professional advice should be sought for all vehicle installations. The installation of amateur radio equipment may have to be disclosed to the vehicle insurers.

Any tests following mobile radio equipment installation should be done with the vehicle stationary, with all vehicle electronic systems operating, before any on-road tests are carried out.

Vehicle ignition and battery charging systems can cause electrical interference to reception on mobile radio equipment.

7.6 Handling interference complaints

Interference from your amateur radio station has the potential to cause neighbour disputes. In such cases, it's worth conducting tests in cooperation with the person who's complaining.

Keeping a transmission log can be of help when dealing with complaints of interference. If you and the person complaining keep a log, you can confirm whether or not it's you who is causing the interference.

If you need advice on resolving interference, the RSGB produces EMC and Interference information leaflets. Remember that advice is available from the RSGB EMC Committee.

Your neighbour can potentially get Ofcom involved with cases of interference (a callout fee may apply). If you are found to be causing interference, Ofcom has the power to require modification, make restrictions, or even shut down your station.

8. Safety

This section accounts for 3 marks in the Foundation exam.

Remember that safety is **everybody's** responsibility, and you must be alert to any potentially unsafe circumstance. This applies to your own station setup, when entertaining visitors, whilst operating "portable" and at club events.

If you see something unsafe, warn others and report the matter to the appropriate person. If you are unsure about any potential safety issue, seek advice.

8.1 Electrical safety

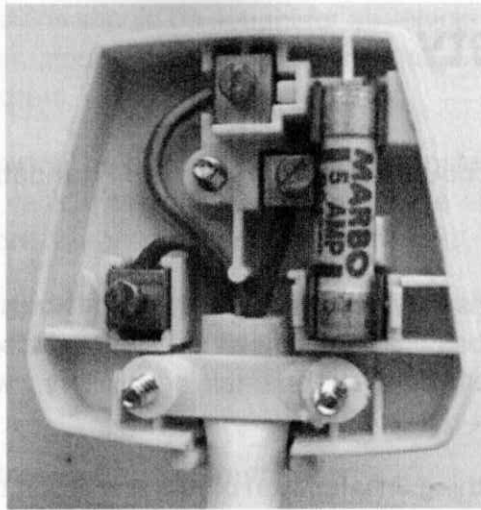
High voltages carry a risk of electrocution, and high currents carry a risk of overheating and fire.

Where a safety earth has been fitted, it must not be removed.

Special care is needed with earthing arrangements, and a competent professional must be consulted prior to making any modifications.

You are required to know how to wire a UK mains plug. The colours are as follows:

LIVE:	Brown
NEUTRAL:	Blue
EARTH:	Green and Yellow



Inside a UK mains plug

Check for the correct value fuse, make sure the flex is secured, and watch for "whiskers" (small strands of metal).

Contact with both Live and Neutral may result in a fatal injury.

You should only work inside equipment with the power sources disconnected. It is important to follow the manufacturer's instructions for servicing equipment.

8.2 Fuses

A fuse is a safety device that contains a thin wire designed to melt (breaking the circuit) when an excessive current flows through the fuse. The reason for a "blown" fuse needs to be properly investigated.

Mains fuses must be fitted in accordance with the manufacturer's instructions.

A Residual Current Circuit Breaker with Overcurrent (RCBO) will offer better protection against a shock than a standard fuse. An RCBO will detect currents to earth of about 30mA, whereas a fuse will only blow at several amps and only when the fault is a short circuit (e.g. Live-to-Neutral, or Live-to-Earth).

8.3 Station safety

All equipment should be controlled by a clearly marked master "off" switch, and its location should be made clear to everyone in the property. In the event of an accident or fire involving electricity, the first action is to switch off the power. Casualties must not be touched unless the power has been switched off.

Make sure you don't have wires trailing across the floor, such as mains, coaxial or headphone cables (as they are trip hazards), and watch for other trip hazards and the risk of frayed insulation.

When listening using headphones, be aware that listening at excessive volume can cause hearing damage, and the damage can be cumulative.

Operating outdoors can introduce new hazards, such as temporary power arrangements, trailing cables and damp ground. Extra safety precautions should be taken whilst operating outdoors, such as completing a risk assessment, care with routing cables, correct fusing and use of RCBOs.

8.4 Battery safety

Some batteries can supply very high currents, which can be hazardous if short-circuited.

With rechargeable batteries, charging must be in accordance with the manufacturer's instructions. Different battery technologies require different charging techniques and must use the correct type of charger. Lithium batteries in particular can cause fire and explosion if not properly treated.

8.5 Tool safety

Eye protection must be worn when using tools to prevent damage from small metal particles, known as swarf. Eye protection must be worn when soldering to prevent solder or flux from splashing into the eyes.

All tools, including power tools, can be hazardous and should be handled with care and appropriate precautions taken.

When using a soldering iron, a soldering-iron stand must be used to avoid skin contact with the hot bit of the iron when not in use. The area must be well-ventilated to avoid inhalation of solder fumes, which can cause breathing problems, particularly for asthmatics.

8.6 Antenna safety

Particularly high antennas may need special protection against lightning. Your local authority building department may be able to offer advice.

Elevated wires, masts and antennas must be suitably located and secured.

Antennas and feeders must not be sited close to overhead power cables.

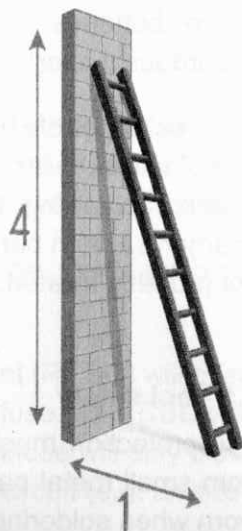
A lethal electric shock can result from antennas and ladders coming into contact with or attracting arcing from overhead lines.

8.7 Working at height

Putting up antennas is potentially hazardous. It is advisable to have someone to help you. At least one adult should be present.

A ladder should be used at the correct angle (4:1 height-to-base ratio).

Ladders must be adequately secured to prevent them from slipping. You must not “overreach” from a ladder, as this increases the risk of falling.

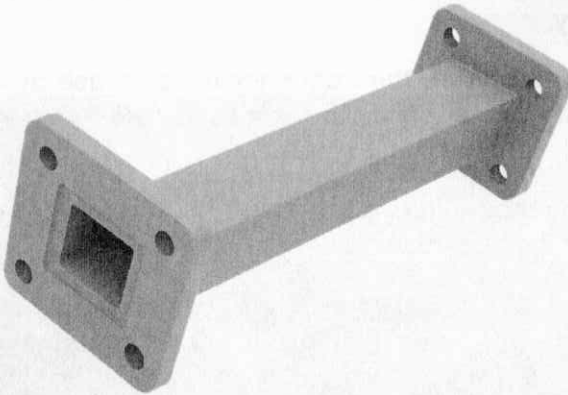


When working at height, a tool belt or similar device to carry tools should be used, as this may help to prevent falling objects. Hard hats should be worn when you or others are working at height.

8.8 Working with RF

The main health effect of exposure to electromagnetic radiation is the heating of body tissue. Note that eyes are particularly susceptible to damage. Guidance on safe levels of RF radiation is available from various government and international bodies, the Health Security Agency and the International Commission on Non-Ionising Radiation Protection (ICNIRP).

A waveguide is a device that focuses radio waves, typically at microwave frequencies. Looking down a waveguide, or standing too close to high-gain antennas whilst in use, can be dangerous.



A waveguide

Antenna elements and other conductors carrying RF should not be touched whilst transmitting.

Antennas should be mounted so that people will not come into accidental contact with them.

9. Operating Procedures

This section accounts for 3 marks in the Foundation exam.

9.1 VHF calling

Here is an example of how to make a call on 2m (VHF):

- Tune to the “FM Calling” frequency of 145.500MHz.
- Before calling, you need to listen to the frequency to make sure it's not in use by someone else.
- If not in use, you can call for a specific callsign, or call “CQ”.
- Once you've established contact with someone, you need to move off the calling frequency so that others can use it. Look for a free frequency.
- Listen to make sure the frequency is not in use by another user (or another mode), then put out a call to ask, “Is the frequency in use?”
- If the frequency is free, go back to “FM Calling”, call your contact, and send them to the new frequency.



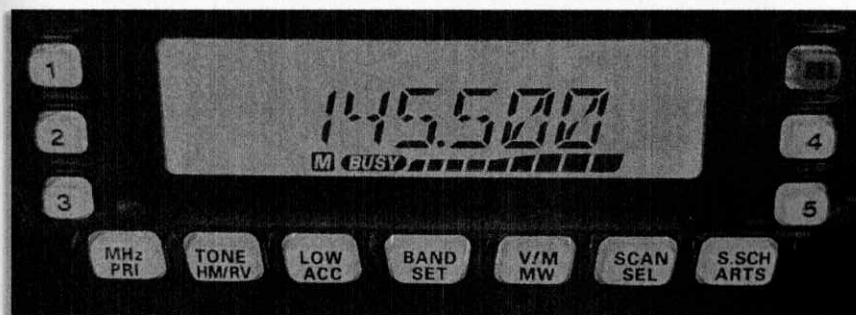
For a video of an example contact, go to www.sxham.uk/trainvids

9.2 Signal reports

Signal reports are given using “RST” codes: Readability, Strength, and Tone.

A signal report of “Five and Nine” would be totally readable and very strong.

Readability	Strength	Tone
<i>How well you can “read” (understand) the message</i>	<i>How strong the signal is (on the on-screen display)</i>	<i>For Morse and Data – what is the quality of the tone</i>
1 = Unreadable	1 = Faint	1 = Extremely rough
3 = Readable with difficulty	5 = Fairly good	5 = Note with ripple
5 = Totally readable	9 = Very strong	9 = Pure



Radio receiver, showing a received signal strength of 9

9.3 Callsign suffixes:

You can optionally add a suffix to the end of your callsign to tell others about your operating conditions.

Here are the four common suffixes to remember for your exam:

Suffix	Meaning	Example
/M	Mobile: Car, pedestrian or inland waters	MM7ABC/M
/A	Alternate Postal Address, e.g. a hotel	2EØAAA/A
/P	Temporary: Field event with no postcode	M7PPP/P
/MM	Maritime Mobile (Vessel at sea)	MØQQQ/MM

On-air, you would commonly say "M7ABC stroke P" or "M7ABC slash P". Remember that suffixes must not be offensive or used to obscure your identification.

9.4 Phonetic Alphabet

Commonly used on HF, where it can be harder to hear signals. Potentially tested on the exam:

A	Alpha	H	Hotel	O	Oscar	V	Victor
B	Bravo	I	India	P	Papa	W	Whiskey
C	Charlie	J	Juliet	Q	Quebec	X	X-ray
D	Delta	K	Kilo	R	Romeo	Y	Yankee
E	Echo	L	Lima	S	Sierra	Z	Zulu
F	Foxtrot	M	Mike	T	Tango		
G	Golf	N	November	U	Uniform		

9.5 Logs

Logs are not mandatory, but they are good practice, helpful for contests and awards, and for confirming contacts.

You can use logging apps, online services or paper logs.

You typically log: Callsign, Date, Time, Frequency and Mode. Logging is done in UTC, also known as GMT (so that overseas logs match).

Ofcom can mandate logging to help identify interference and compliance issues.



Example of a paper logbook for use "in the field"

9.6 Bad behaviour

Transmitting music and the use of offensive or threatening language whilst on the air are unacceptable.

Don't respond to any abuse you may encounter, and don't confront the perpetrator. If abuse is persistent, keep a log.

9.7 Band plans

A Band Plan is used to be fair to other users. For the exam, you will find the 2m (144MHz) and 20m (14MHz) band plans in the 4-page exam booklet.

144 (2m)	Necessary Bandwidth	UK Usage
144.000-144.025	2700Hz	All modes - including Satellite downlinks
144.025-144.100	500Hz	Telegraphy (including EME CW)
		144.050 Telegraphy Centre of Activity
		144.100 Random MS telegraphy calling (Note 1)
144.100-144.150	500Hz	Telegraphy and MGM
		EME MGM activity
144.150-144.400	2700Hz	Telegraphy, MGM and SSB
		144.250 GB2RS news broadcast and slow Morse
		144.260 See Note 10
		144.300 SSB Centre of Activity
		144.370 MGM MS calling
144.400-144.490		Propagation Beacons only
144.490-144.500		Beacon guard band
144.500-144.794	12 kHz	144.491-144.493 Personal Weak Signal MGM Beacons (BW: 500 Hz max)
		All Modes (Note 8)
		144.500 Image Modes (SSTV, Fax etc)
		144.600 Data Centre of Activity (MGM, RTTY etc)
		144.6125 UK Digital Voice (DV) calling (Note 9)
		144.625-144.675 See Note 10
		144.750 ATV Talk-back
144.794-144.990	12 kHz	144.775-144.794 See Note 10
		MGM / Digital Communications
		144.800-144.9875 Digital modes (including unattended)
		144.8000 Unconnected nets - APRS, UIView etc (Note 14)
		144.8125 DV Internet voice gateway (IARU common channel)
		144.8250 DV Internet voice gateway (IARU common channel)
		144.8375 DV Internet voice gateway (IARU common channel)
		144.8500 DV Internet voice gateway (IARU common channel)
		144.8625 DV Internet voice gateway (IARU common channel)
		144.8750 - 144.9125 - Internet Gateways
		144.9250 Digital usage
		144.9375 Digital usage
		144.9500 Digital usage
		144.9625 FM Internet voice gateway
144.990-145.1935	12 kHz	144.9750, 144.9875 Low power / Adhoc repeater inputs (Note 11)
145.200	12 kHz	FM/DV RV48 - RV63 Repeater input exclusive (Note 2) (Note 5)
		FM/DV Space communications (e.g. I.S.S.) - Earth-to-Space
		145.2000 (Note 4) & (Note 10)
145.200-145.5935	12 kHz	FM/DV V16-V47 FM/DV simplex (Note 3) (Note 5) (Note 6)
		145.2250 Internet gateways - and See Note 10
		145.2375 FM Internet voice gateway (IARU common channel)
		145.2500 Used for slow Morse transmissions
		145.2875 FM Internet voice gateway (IARU common channel)
		145.3375 FM Internet voice gateway (IARU common channel)
		145.5000 FM calling (Note 12)
		145.5250 Used for GB2RS news broadcast
		145.5500 Used for rally/exhibition talk-in
		145.5750, 145.5875 Low power / Adhoc repeater outputs (Note 11)
145.5935-145.7935	12 kHz	FM/DV RV48 - RV63 Repeater output (Note 2)
145.800	12 kHz	FM/DV Space communications (e.g. I.S.S.) - Space-Earth
145.806-146.000	12 kHz	All Modes - Satellite exclusive

Example of the 2m band plan. Due to print size and copyright restrictions, we cannot print the full table in this guide.

Print out and use the RSGB 4-page exam booklet.

You may be asked questions about items in those two band plans. Some things to watch for in the band plans:

- Narrow modes (CW & data) are mostly near the lower frequencies within each band.
- Sideband: Below 10MHz, Lower Sideband (LSB) is normally used, and over 10MHz, Upper Sideband (USB) is normally used.
- "Centre of Activity" is where to start looking for contacts on a specific mode, for example, 144.300MHz for SSB.
- Watch the exceptions: Beacons, repeater input and output frequencies, and space-only frequencies.

144 (2m)	Necessary Bandwidth	UK Usage
144.000-144.025	2700Hz	All modes - including Satellite downlinks
144.025-144.100	500Hz	Telegraphy (including EME CW)
		144.050 Telegraphy Centre of Activity
		144.100 Random MS telegraphy calling (Note 1)
144.100-144.150	500Hz	Telegraphy and MGM
		EME MGM activity
144.150-144.400	2700Hz	Telegraphy, MGM and SSB
		144.250 GB2RS news broadcast and slow Morse
		144.260 See Note 10
		144.300 SSB Centre of Activity
		144.370 MGM MS calling
144.400-144.490		Propagation Beacons only
144.490-144.500		Beacon guard band

145.200-145.5935	12 kHz	FM/DV V16-V47 FM/DV simplex (Note 3) (Note 5) (Note-6)
		145.2250 Internet gateways - and See Note 10
		145.2375 FM Internet voice gateway (IARU common channel)
		145.2500 Used for slow Morse transmissions
		145.2875 FM Internet voice gateway (IARU common channel)
		145.3375 FM Internet voice gateway (IARU common channel)
		145.5000 FM calling (Note 12)
		145.5250 Used for GB2RS news broadcast.
		145.5500 Used for rally/exhibition talk-in
		145.5750, 145.5875 Low power / Adhoc repeater outputs
145.5935-145.7935	12 kHz	FM/DV RV48 - RV63 Repeater output (Note 2)
145.800	12 kHz	FM/DV Space communications (e.g. I.S.S.) - Space-Earth
145.806-146.000	12 kHz	All Modes - Satellite exclusive

9.8 Frequencies

Radio frequency bands are allocated for a particular use, such as broadcasting, aeronautical, maritime and amateur radio. Some amateur bands are shared with, or adjacent to, other spectrum users.

In the exam, you may be asked to identify other spectrum users from the table found in the 4-page exam booklet.

Frequency Allocation Table	
Frequency (MHz)	Use
87.5 - 108.0	Broadcasting
108.0 - 117.975	Aeronautical Radionavigation
117.975 - 137.0	Aeronautical Mobile
137.0 - 138.0	Space Operations & Space Research
138.0 - 144.0	Land Mobile
144.0 - 146.0	Amateur & Amateur Satellite
146.0 - 149.9	Mobile (except aeronautical mobile)
149.9 - 150.05	Radionavigation-Satellite
150.05 - 152.0	Radio Astronomy
152.0 - 156.0	Land Mobile
156.0 - 158.525	Maritime Mobile
158.525 - 160.6	Land Mobile
160.6 - 160.975	Maritime Mobile

Example – Refer to the full table in the 4-page exam booklet

For the exam, you will need to be able to recognise the frequency bands for HF, VHF and UHF:

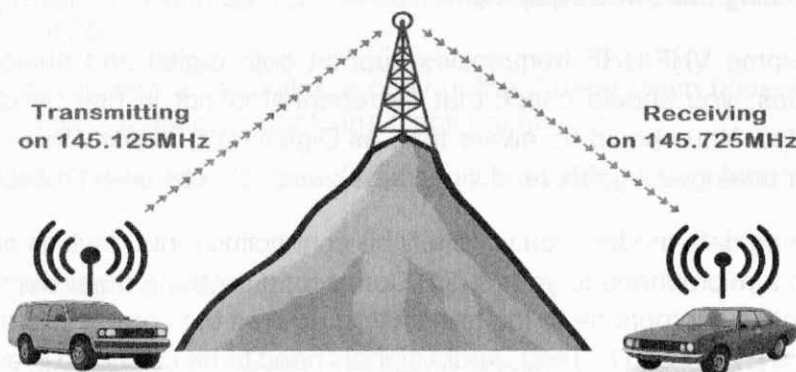
HF (High Frequency):	3-30MHz
VHF (Very High Frequency):	30-300MHz
UHF (Ultra High Frequency):	300-3000MHz

9.9 Repeaters

Repeaters are mainly intended to extend the range of mobile stations.

Repeaters have an “input” and an “output” frequency so that they can transmit and receive at the same time. You don't need to remember this for the exam, typically (but not always):

- 2m (VHF) repeaters transmit 600kHz above their input frequency.
- 70cms (UHF) repeaters transmit 1.6MHz or 7.6MHz below the input frequency.



Repeater input and output

CTCSS tones are low-frequency tones that are transmitted as part of your audio. Repeaters will only activate if they ‘hear’ the correct CTCSS tone. This is to stop the repeater from transmitting if it ‘hears’ interference. There are nine blocks of tones used in the UK (identified by letters) so that frequencies can be shared across the UK. You must program your radio to transmit the right CTCSS tone.

Many repeaters have “timeouts” to cut down on long transmissions (typically transmissions over a few minutes). After someone stops transmitting, listen for a short reset tone or similar noise before you start transmitting. This tone resets the repeater timeout.

Check the band plan to make sure that you don't have normal two-way (simplex) chats on frequencies intended for repeater use.

9.10 Digital Voice and Data

There are several Digital Voice (DV) and Digital Data (DD) modes available. The common DV systems are **D-Star** (used by the manufacturer iCom), **C4FM Fusion** (used by Yaesu) and **DMR** (used by multiple manufacturers). These different systems are not usually compatible with each other, and appropriate radio equipment is needed for each of these systems.

DV radios often have a software setting that embeds the callsign or a unique ID in the transmission, and this may need to be changed if you are using borrowed equipment.

As some VHF/UHF frequencies support both digital and analogue modes, you should check that the channel is not in use by other modes. You should be aware that, as Digital (DV) radios often can't hear analogue signals (and vice versa), such checks aren't reliable.

If using data modes, you will likely be connecting input devices other than a microphone to your radio. Connecting anything other than the supplied microphone to the transmitter requires the correct operation of the PTT (Push to Talk). Audio signals need to be correct to prevent distortion or interference.

9.11 Satellites

Amateur satellites operate in allocated frequencies within the bands (check the band plan).

You should not use satellite frequencies for non-satellite operating.

9.12 International Operating

The licensing section of this guide covers where you can operate. For operating overseas, remember that other Administrations (regulators in foreign countries) do not routinely recognise the Foundation Licence, but some countries may make exceptions.

10. Exam Information

Ready to take your exam? Great! There are a couple of different ways to take your exam - either at home (remotely invigilated) or at a local amateur radio club.

10.1 About the exam

The Foundation exam lasts for 60 minutes, and the exam software will present you with 26 multiple-choice questions. The pass mark is 19 out of 26.

You are allowed a calculator, a copy of the 4-page exam booklet, a drink, a pen or pencil, a drink and blank paper.

A photo ID is required to prove that you are genuinely the candidate.

10.2 Taking the exam at home

If you decide to take the exam at home, this will be conducted by the RSGB, and you can book an exam slot online on the RSGB exam website. (Shortlink: **www.sxham.uk/bookexam**)

The exam uses special software, and you're monitored over a webcam to ensure there's no cheating. Here are the technical requirements for the online exam:

- Operating system: Windows 7 (or later) or Mac OS 10.10 (or later)
- Hardware: Intel Core i3 (or equivalent) and 4GB RAM.
- Screen: Recommended minimum of 13", resolution of 1024 x 768
- A working webcam (USB, or built-in laptop webcam)
- A working microphone and speakers
- Good, continuous internet speed, ideally 2Mbps

The exam cannot be taken using a smartphone, tablet, Chromebook or on a computer running Linux.

A few days before your exam date, you will be sent a link to the exam software, TestReach, plus a username and password needed to use

the exam software. There is a tutorial that you can use to get familiar with how to use the system during your exam. You will also have a video call with the invigilator a few days before the exam to check that everything is working and to ask any questions you may have about the actual exam.

10.3 Taking the exam at a club

If you'd prefer not to take your exam online, you can potentially take your exam with the help of one of the UK's many amateur radio clubs. It's a case of locating your nearest club(s), visiting their website and making contact to see if they have any exam sessions planned.

It's common to pay a little extra for an in-person exam to help the club cover their costs in hiring an exam venue.

You will find a list of amateur radio clubs on the RSGB website at www.rsgb.org.uk.

10.4 Exam Hints & Tips

Here are some handy tips for taking your Foundation amateur radio exam and getting the best result possible.

Preparation

Make sure you have studied all of the material – this guide contains all of the information you need to pass the exam, but use other sources too. Obviously, we're keen to recommend our own Foundation Online course, but there are others. You can also take a course or get help from your local amateur radio club, or watch various videos on YouTube.

As part of our course, and on the Essex Ham YouTube channel, look for our "Exam Hints and Tips" video as well as our Quick Revision Guide, which covers common exam topics.

Don't wait too long between studying and taking the exam (as you'll forget what you've learnt)

Take some mock tests – you shouldn't even think about booking your exam until you can regularly get 19/26 or better on mock tests. Be warned – some online mock websites have not been updated to the current exam syllabus, so check that mocks are up-to-date.

Spend some time getting familiar with the 4-page exam booklet - what table does what, and how to look things up.

The numbers game

If there is something you don't understand, don't worry too much. At Foundation, you can get seven questions wrong and still pass. Here's our guide:

- Licence Conditions and Operating Procedures – 9 marks (a third of the exam), and you'll need to know most of this when you have your licence. Put in some effort and take your time here. There are usually 3 questions based on the 4-page exam booklet, so use it!
- Safety – 3 marks, mostly common sense.
- Interference (EMC) – 3 marks, fairly straightforward stuff.
- Propagation – Only 2 marks, and useful stuff to know.
- Antennas – 3 marks. The antenna types are useful information. Remember that the gain table is in the 4-page exam booklet.
- Transmitters and Receivers – 3 marks. The box diagrams and sidebands can be tricky.
- Technical Basics – Possibly the hardest section, with the formulas and circuits to study, but it only accounts for 3 marks. The good news is you can fail this section, get another 4 questions wrong, and still pass. Don't stress this one too much.

The day of the exam

Take a couple of mock tests. Then, have a quick review of the areas where you know you're weak.

Review some of the more challenging areas that might come up in the exam, for example:

- ☐ The two formula triangles
- ☐ Receiver, transmitter and SDR block diagrams
- ☐ Callsigns and Regional Secondary Locators
- ☐ The five standard antenna types
- ☐ Have a scan through the 4-page exam booklet, and refresh your memory on the Schedule and Band Plan exclusions.

If you're using your computer to take the exam, make sure that it has had all of its operating system and anti-virus updates, as you don't want your computer to be slowed down or interrupted for software updates during your exam.

Just before the exam

Make sure you have everything ready and are comfy. You're allowed a drink during your exam (we suggest non-alcoholic!).

Make sure you have your 4-page exam booklet, a pen, some blank paper and a calculator. No other notes are allowed in the exam.

Relax! The exam isn't life or death - if you don't pass the first time, who cares? You can always take it again when you're more prepared.

During the exam

The exam time is one hour, which is plenty of time. Many people finish earlier, but don't be rushed. We recommend you spend at least one minute per question.

Here is what you need to do with each question:

- Read each question carefully.
- Read through every single answer – don't just pick the first one that "sounds sort of right".
- Work out which of a question's answers are definitely wrong.
- Select the answer that is MOST right, not the first one that looks right.
- Use the exam booklet every time a frequency is mentioned, to check what the rules are for that frequency.

At the end of the exam, go through all of the questions and answers again, asking yourself, "Am I sure this is the best answer?"

After the exam

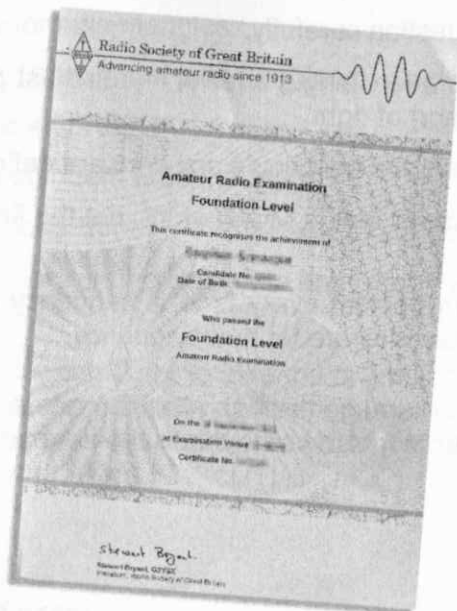
If you thought one or more of the questions were unfair, tell the exam invigilator – there is a mechanism for reporting (challenging) problem questions which may be unfair (badly worded, confusing, using jargon, or just plain trick questions).

Take a note of any such question (either the wording or the question reference number), and report any such question to the Invigilator after the exam. We'd also encourage you to report the question to us, so we can challenge this with the RSGB on your behalf, and help to make sure other students are prepared.

You can report a question using this shortlink: www.sxham.uk/report

11. After You've Passed

Once you've passed your Foundation exam, you'll receive a pass certificate from the RSGB in the post – this certificate includes your candidate number, which will be needed to obtain your licence and callsign.



Sample Foundation Pass Certificate

Once you have your pass certificate, you will need to create an account on the Ofcom Licensing website.

Remember to keep a note of your password, as you'll need to log on to validate your licence every 5 years.

When you have created your Ofcom account, you can apply for your free licence using the Candidate number printed on your pass certificate. At this point, you'll be able to choose your amateur radio callsign.

Selecting a callsign

At the time of writing, the Foundation callsign prefix is "M7", and you're able to choose your own callsign on the Ofcom website, provided it has not already been taken. We have a handy checker on our website to allow you to check in advance to see if your preferred callsign has been taken - Shortlink: www.sxham.uk/m7check

Getting your licence

Once you have selected a valid callsign, you'll be able to print and download a PDF copy of your licence.

Amateur Radio Licence
Licence de radio amateur
Amateurfoundation

United Kingdom of Great Britain & Northern Ireland, the Channel Islands & the Isle of Man
L'Édition sur la République de France, les îles Anglo-Normandes et l'Isle de Man
Veuillez télécharger vos documents (certificats, etc.) sur Internet, car nous ne pouvons pas vous les envoyer.

Wireless Telegraphy Act 2006
L'Édition sur la République de France, les îles Anglo-Normandes et l'Isle de Man
Veuillez télécharger vos documents (certificats, etc.) sur Internet, car nous ne pouvons pas vous les envoyer.

Licence de radio amateur
Licence de radio amateur

Licence de radio amateur	Amateur Foundation Radio Licence
NAME	
SURNAME	
CLUB NAME	
DATE OF BIRTH	
DATE OF ISSUE	
CALLSIGN	
DATE OF ISSUE	
DATE OF EXPIRY	

Notes

Page 1 of 2

Sample Foundation Licence document

The printable version of your licence is a two-page document – you may also find it useful to download and/or print Ofcom's Amateur Radio Licence Conditions Booklet OFW611. This 24-page document contains the actual licence conditions that you'll need to comply with, and is a handy source of reference when deciding what you can and can't do on-air.

What next?

Once you have your licence and callsign, you're on your way, and you're free to explore the world of amateur radio. There are so many options open to you that it's impossible to give any real guidance in this study guide, but here are a few options to consider:

More study: The next licence level is Intermediate. Some people will be happy staying at Foundation, whilst others may want to dive into studying for the next level, while Foundation is still fresh. As with Foundation, there are various courses, books and online study resources. Before you ask, HamTrain does not offer an Intermediate course, but there are several other courses out there, and you can find a list of study resources at www.hamtrain.co.uk

Getting on the air: Many will be keen to get on air as soon as possible and start making contact with others. There are a few things to consider first, including what equipment to get, plus the practicalities of making contacts. As there are so many options (handheld, base station, mobile, HF or VHF/UHF, analogue or digital, etc), you'll need to think about your options here, perhaps seeking advice in our online forum, Facebook or Discord groups. It's also a good idea to do some listening first, to get used to the etiquette.

Connecting with locals: Many people start out on VHF/UHF, often with a cheap handheld radio. These do have limitations in terms of range and build quality, but they will allow you to listen in to local activity and hopefully access a nearby repeater. You can start to make local contacts, and perhaps take part in 'nets'. It's also worth checking out your local amateur radio club – they can be a mixed bag, but they can be a great way to meet local amateurs and get some advice. Local events, whether at a club, a special event station or a "rally", provide excellent opportunities to meet like-minded locals and form new friendships in the amateur radio community.

Online resources: Consider becoming a free member of Essex Ham (you don't have to be from Essex) – we have various videos, several "Getting Started Guides", a forum, a Facebook group, a Discord server and a newsletter. Find out more at www.essexham.co.uk as well as www.hamhub.uk

12. Glossary

Some of the terms that you may experience when studying for your Foundation exam:

Term	Description
AM	Amplitude Modulation. A method of combining audio with a carrier to create a radio signal. The audio changes the amplitude (height) of the carrier's waveform.
AMU	Antenna Matching Unit. Used to "match" antenna impedance to the transmitter, to reduce VSWR.
Attenuate	To reduce the energy of a radio signal. Heavy rain attenuates (reduces the strength of) radio signals at UHF.
Balun	A device that couples balanced and unbalanced feeder/antennas. For example, you would use a balun to connect a balanced antenna (such as a dipole) to an unbalanced coaxial cable.
CQ	A general call asking for someone to make contact with you.
CW	Continuous Wave – Also known as Morse Code.
CTCSS	Continuous Tone Coded Squelch System. Sub-audible tone by your radio sent alongside a transmission, to allow a repeater to "open".
dB (Decibels)	Measurement of gain (or loss). At Foundation, recall that Yagi (beam) antennas have a gain measured in dB.
EMC	Electro-Magnetic Compatibility. The avoidance of interference between equipment.

EMF	Electro-Magnetic Fields. Amateurs are required to ensure that the EMF they generate is below the recommended limits.
EIRP	Effective Isotropic Radiated Power – Power being radiated by your antenna (compared to a theoretical "isotropic" antenna).
ERP	Effective Radiated Power – The power your antenna is outputting (calculated by multiplying the power in watts by the antenna's "gain" when compared to a half-wave dipole antenna).
FM	Frequency Modulation. The audio signal changes the frequency of the carrier's waveform.
Impedance	An antenna has an impedance, which is measured in Ohms at the feed point. The impedance depends on the size and shape of the antenna, how it's positioned, and the frequency transmitted.
Ionosphere	A layer of ionised gases 70-400km above Earth, that refracts HF radio signals back to Earth.
Q Codes	Shorthand codes that are used on amateur radio. Common examples: QTH (Location), QSL (confirm receipt), QRZ (Who is calling?), QRM (interference), QRP (low power), QSY (Change frequency) and QSO (contact).
RF	Radio Frequency.
SSB	Single Sideband. Either USB (Upper Sideband) or LSB (Lower Sideband). These are methods of transmission.
VSWR	Voltage Standing Wave Ratio. Shows how much power is being reflected back from the antenna. (1:1 is perfect; over 3:1 might be causing damage to the transmitter).

13. Foundation Mock Exam

Our free Foundation Online course includes various quizzes and mock tests, and we have loads of mocks available via our online classroom and website. We strongly advise you to take some mock tests before you book and sit your actual Foundation exam.

To help see how you're progressing, here are 26 questions from our mock question bank.

Find yourself a piece of paper and a pen, and jot down the answers to all 26 mock questions to see how you get on. The answers can be found in Appendix B.

Question 1

Which of the following is NOT permitted by the amateur radio licence?

- a) Talking about the weather
- b) Discussing the makes and models of radios
- c) Advertising prices of your home-made antennas
- d) Use of codes

Question 2

You're chatting to a friend and decide to change frequency as you can hear another station. Once on the new frequency, what should you do?

- a) Note the time, date and frequency in your log
- b) Make sure you give your callsign
- c) Wait for 30 minutes to make sure the frequency is not in use
- d) Return to the calling frequency

Question 3

The operator of a station who contacts you does not give their callsign, even when asked more than once. What action should be taken?

- a) Report the incident to the police
- b) Keep repeating the question
- c) Terminate the contact
- d) Note the contact in your log

Question 4

Any individual authorised by Ofcom has the right to do what?

- a) Close down your amateur radio station
- b) Require that you modify your amateur radio equipment
- c) Restrict the operation of your amateur radio equipment
- d) All of the above

Question 5

At Foundation, can you transmit to a satellite on 437.990MHz?

- a) No
- b) Yes, as a primary user
- c) Yes, as a secondary user
- d) Yes, provided you are 100km away from Charing Cross

Question 6

Ofcom requires radio amateurs to keep records of what?

- a) EMF assessments
- b) Contacts outside of the UK
- c) Changes to your station equipment
- d) Operations away from your Main Station Address

Question 7

Which of the following is an electrical insulator?

- a) Gold
- b) Copper
- c) Brass
- d) Ceramic

Question 8

Which of the following frequencies would you find on the HF bands?

- a) 909kHz
- b) 14.070MHz
- c) 145.5MHz
- d) 432.6MHz

Question 9

What is NOT true of analogue signals?

- a) They can constantly change in amplitude
- b) They can constantly change in frequency
- c) They are a stream of finite values
- d) Amplitude and Frequency can vary constantly

Question 10

Which of the following describes the process of "Modulation"?

- a) Ensuring that the transmitter is on the same frequency as the distant receiver
- b) Extracting the transmitted data or voice from the radio frequency carrier
- c) Ensuring that the transmitter is on the same frequency as the local receiver
- d) Adding the data or voice to be transmitted to the radio frequency carrier

Question 11

A transmitter's RF power amplifier should be...

- a) Connected to a correctly matched antenna
- b) Connected to the output of the demodulator
- c) Tuned to the precise transmit frequency
- d) Adjusted using the squelch control

Question 12

In a receiver, what does a detector do?

- a) Tunes in to the required signal
- b) Amplifies a weak signal
- c) Removes the carrier
- d) Detects the frequency to generate

Question 13

What type of feeder is "balanced" (having equal and opposite signals in two wires)?

- a) Coaxial cable
- b) Twin Feeder
- c) SMA
- d) Screened

Question 14

Which of the following is TRUE:

- a) ERP is calculated by multiplying watts by gain
- b) A Dipole antenna has a typical SWR of 1:4
- c) All Yagi antennas are omnidirectional
- d) As frequency increases, so does the antenna size

Question 15

Which type of cable is fitted to a PL259 plug?

- a) Two core AC mains
- b) Three core AC mains
- c) Ladder-line
- d) Coaxial cable

Question 16

The layers of conductive gases that are between 70 and 400km above the Earth are known as the

- a) troposphere
- b) ionosphere
- c) mesosphere
- d) Van Allen belt

Question 17

Which of the following is more likely to attenuate (reduce) the range of UHF signals?

- a) Snow and Ice
- b) The time of day
- c) Skywave propagation
- d) Tropospheric ducting

Question 18

A piece of equipment's ability to work properly in the presence of strong RF signals is known as what?

- a) Immunity
- b) Resilience
- c) Conductivity
- d) Durability

Question 19

If fitting a filter to reduce interference from a radio signal, where should it be fitted?

- a) As close to the transmitter aerial as possible
- b) As close to the transmitter as possible
- c) As close to the receiver aerial as possible
- d) As close to the affected equipment as possible

Question 20

It is proving difficult to determine how an amateur transmission is interfering with a neighbour's television. The amateur should try getting advice from whom?

- a) The Radio Society of Great Britain
- b) The British Standards Institution
- c) The planning department of the local council
- d) The Radio Licensing Centre

Question 21

Why is UTC used for logging purposes?

- a) It allows the shack clock to be left on the same setting all year round
- b) It is specified in the amateur radio licence by Ofcom
- c) It is used worldwide to avoid confusion of different time zones
- d) It saves having to remember whether it is GMT or BST

Question 22

APRS is a data mode used to allow amateur radio operators to find each other on maps. It works by transmitting callsign and location data over amateur radio. Which of the following frequencies is used for APRS?

- a) 144.300MHz
- b) 144.600MHz
- c) 144.800MHz
- d) 144.950MHz

Question 23

It's recommended that you ask an amateur radio friend to comment on your transmitted audio signal when you start using a new microphone. Why is this?

- a) The transmit frequency might need adjusting
- b) The microphone may be tuned to the wrong band
- c) To prove that it wasn't a waste of money
- d) The microphone gain on the transmitter may need to be re-adjusted

Question 24

The inside of a mains fuse contains what?

- a) a coil of thin wire wound around a core
- b) a piece of metal designed to melt at a certain current
- c) An insulated ferrite ring
- d) two metal plates separated by an insulator

Question 25

Eye protection should be worn when drilling in order to

- a) hold your glasses (if worn) in place
- b) allow closer inspection of the work
- c) prevent swarf from entering your eyes
- d) protect your employer's safety record

Question 26

Transmitters connected to particularly high antennas may need special safety protection against what?

- a) Lightning strikes
- b) Strong RF fields
- c) Low SWR
- d) ICNIRP

The pass mark is 19 out of 26, and you'll find the answers in Appendix B.

There are several more mock tests on the HamTrain website:
www.hamtrain.co.uk

14.FAQ: Your Questions Answered

Q. How do I book an exam?

If you want to take your exam online, book a time and date on the RSGB website. Shortlink: **www.sxham.uk/bookexam**

If you'd rather take your exam at a local exam centre, contact your local amateur radio club. Shortlink: **www.sxham.uk/rsgbclubs**

Q. What do I bring to my exam?

- You are allowed to use the 4-page exam booklet in the exam. For exams taken at home, you can print the booklet, but it must be free from additional notes.
- You can take a pen, a pencil and a soft rubber.
- You can use a silent, non-programmable calculator.
- You can take a drink and sweets (remove excess packaging).
- You're allowed a mascot
- Blank paper may be permitted by some examiners (it's not stated in the rules, so check first).
- A non-electronic translation dictionary is allowed where appropriate.

You are not allowed any written notes, course books, phones or smartwatches, or any additional computers.

Q. What webcam do I need?

For exams that you take at home, you will need a webcam so that the invigilator can monitor you during the exam. Before the exam, the invigilator will ask you to move the webcam around so that the room can be checked out.

If your laptop has a built-in webcam, that will be fine; otherwise, you can buy cheap USB webcams online or on the high street.

Q. Can I take the exam on Linux / Chromebook / iPad / Android?

Sorry, no. The exam software only runs on Windows or Mac OS.

If you don't have access to a suitable computer, then you can potentially take the exam at a nearby amateur radio club or borrow a suitable computer for the exam.

Q. Where can I get mock tests?

Mocks are an excellent way to study and can prepare you for some of the unexpected question types that you may get in the actual exam. This guide includes one of our mock tests, and if you're using our online course, you'll also be getting a quiz at the end of each section, plus various mock tests. Extra online mock tests based on our pool of 300 tried and tested mock questions are also available from us via our website.

There are also free printable mock tests on the RSGB website, and we have released a book of mock questions (search for HamTrain's Foundation Mock Tests). There are also various mock apps and websites, but we're aware that several of these are not up-to-date and don't reflect recent syllabus changes. Always check that any mocks are based on the current syllabus.

For a list of mocks, go to shortlink: **www.sxham.uk/mocks**

Q. I need help with the 4-page exam booklet

You will need to have a paper copy of this with you during the exam. If you are taking the exam at home, print off a copy from shortlink: **www.sxham.uk/ex307**

On that web page, we also have a video that goes through each page of the exam booklet, showing how to use this in your exam.

Can't print the booklet? Ask someone to do this for you, or try a local library or print shop.

Q. The material is not sinking in. Help!

If some of the information just isn't making sense, it could be down to the way you're studying. Reading from a book doesn't suit everyone, which is why we also have videos covering every section of the Foundation syllabus. For those on our free online course, we also have extra videos on the more complex topics, such as sidebands and formula triangles, as well as video examples of making a simple contact and using a repeater. Shortlink **www.sxham.uk/trainvids**

For some, online and book-based training just doesn't work – see if your local club offers training or support, or has a friendly member able to offer some extra coaching and advice on tricky topics.

Q. I need extra help or support

Additional support is available for students who may need extra help with the exam or who have dyslexia or sight issues. We have a page and video for those who need help. Go to shortlink **www.sxham.uk/examhelp**

You should also contact the RSGB Exam Team to see if any adjustments can be made to your exam. You can call them on 01234 832700 – or see shortlink **www.sxham.uk/rsgbcon**

Q. What happens if I fail?

Everyone wants to pass the first time, but not everyone does, and that's nothing to worry about. If you've prepared properly and crucially, done well in mock exams, then you should have no problem. If you do fail, then take it as a learning experience, study the areas where you went wrong, and simply book another exam session (you'll have to pay the exam fee again).

Amateur radio is a hobby, and there's no shame in failing on the first attempt. You'll just be better prepared for the second attempt.

Q. I had a poor or unfair exam question

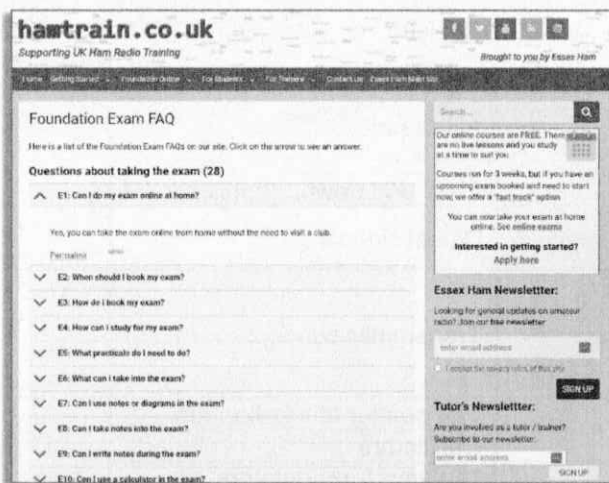
You wouldn't be the first! Some of the exam questions can be a little odd, either written in an unclear manner or using terminology that you weren't expecting. There are a couple of things you can do:

1. Challenge the question formally with the RSGB. If the question is unfair, your exam may be re-marked. Contact the RSGB exam team on 01234 832700 – or see shortlink **www.sxham.uk/faq7**
2. Let HamTrain know. We keep a log of problem exam questions, can challenge these on your behalf, and can warn other students. Log any problem questions at shortlink: **www.sxham.uk/report**

Q. I have a question you haven't answered!

Take a look at our full FAQ here: Shortlink: **www.sxham.uk/faq**

If your question relates to the exam, it may be best to contact the RSGB Exam Team directly. You can call them on 01234 832700 – or see shortlink **www.sxham.uk/faq7**



HamTrain's Online FAQ

15. Syllabus Question Breakdown

Exam questions are set in accordance with the RSGB syllabus. The following table shows how we understand the 26 Foundation exam questions to be apportioned. This may not be 100% accurate and is provided here as a guide only.

Syllabus Ref.	Topic	Exam Question
1A1	Nature, licence and callsigns	1
1A2		
1A3		2
1A4		
1B1	Operators and supervision	3
1C1	Messages	
1C2		
1D1	Apparatus, inspection and closedown	4
1D2		
1G1	Electromagnetic fields	5
1H1	Foundation schedule	6
2A1	Fundamental theory	7
2A2		
2B1	Power	
2C1	Resistance	
2C2		
2C4		
2E1	AC theory	8
2E2		
2E7		
2J1	Cells and power supplies	9
2F1	Digital signals	
2F2		
3A1	Transmitter concepts	10
3A2		
3A3		
3A4		
3B1	Transmitter block diagram	11
3C1	Oscillators	
3E1	Mic amp & modulators	
3F1	RF power amplifiers	
3F3		
3G1	Transmitter interference	
3H1	Receiver concepts	12
3H2		
3K1	Demodulation	
3M1	SDR	

Syllabus Ref.	Topic	Exam Question
4A1	Feeder	13
4A2		
4B1	Baluns	
4C1	Antenna concepts	14
4C2		
4C3		
4C4		
4C5		
4C6		
4D1	Antenna types	
4E1	Standing waves	15
4E2		
4F1		
4G1	Plugs and sockets	
5A1	Propagation concepts	16
5A2		
5B1	Ionosphere	
5B2		
5C1	VHF / UHF	17
5C2		
5C3		
6A1	EMC concepts	18
6A2		
6A3		
6A4		
6B1	Interference sources / Routes of entry	19
6C1		
6D1	Filtering	
6D4		
6E1	Station design (General)	
6E2		
6F1	Station design (Mobile)	
6F2		
6F3		
6G1	Social aspects	20
6G2		
7A1	Good operating practices and procedures	21
7A2		
7A3		
7A4		
7A5		
7A6		
7A7		
7A8		

Syllabus Ref.	Topic	Exam Question
7B1	Band Plans	22
7B2		
7C1	Repeaters	
7C2		
7D1	Input devices to transmitters	23
7E2	Codes and abbreviations	
7F1	Digital Interfaces	
7G1	Satellites	
7H1	CEPT (overseas)	
8A1	Electricity safety	24
8A2		
8A3		
8A4		
8A5		
8A6		
8A7		
8A8		
8B1	Tools	25
8B2		
8B7		
8C1	Working at height	
8C2		
8C3		
8D1	Working with RF	26
8D2		
8D3		
8D4		
8E1	Lightning	
8F1	Working mobile and portable	
8F2		
8F3		
8F4		
8F5		

Note: The syllabus references quoted here will appear on your exam results feedback, so this table can be used to look up which questions you got right or wrong in your final exam.

Appendix A: 2024 Licence Changes

In February 2024, Ofcom made some changes to the amateur radio licence, which are now in effect. When you pass, you will have access to the new conditions. Here is a summary of the changes.

These items became examinable from 01 September 2024:

- ☐ Regional Secondary Locators (e.g. MW7, MM7, MI7, etc) are now optional - except for Intermediate 2x callsigns, where the letter is still mandatory.
- ☐ Those in England can add an optional "E" to their callsign at Foundation and Full (e.g. ME7QQQ)
- ☐ Power increases:
 - Foundation: 25 watts (most bands)
 - Intermediate: 100 watts (most bands)
 - Full: 1,000 watts (primary bands)
- ☐ Ofcom will shortly cease to issue 2x Intermediate callsigns – they will be replaced with M8 and M9.
- ☐ Any suffix is now allowed after a callsign (e.g. "M7QQQ/Garden")
- ☐ Airborne use is now permitted to a maximum of 0.5 watts EIRP (only on primary bands).
- ☐ Supervision of unlicensed people is allowed at all 3 licence levels.
- ☐ There is more flexibility for Beacons, Gateways and Repeaters, and licensing updates to remote and unattended operation.
- ☐ Foundation licence holders can now build their own transmitters.
- ☐ Foundation now has access to 2.4GHz and 5GHz (max 2 watts).

Appendix B: Mock Exam Answers

1	C	Licensing	<i>Business / Commercial activity is not permitted. Codes, such as Morse, are permitted.</i>
2	B	Licensing	<i>You need to give your callsign when establishing contact on a new frequency.</i>
3	C	Licensing	<i>You can only talk to other radio amateurs. This person may not be licensed.</i>
4	D	Licensing	<i>Ofcom has the authority to do all of those things.</i>
5	C	Licensing	<i>The answer can be found on page 2 of the 4-page exam booklet.</i>
6	A	Licensing	<i>Amateurs are required to perform an EMF assessment on their station.</i>
7	D	Tech Basics	<i>Ceramic is an insulator; it doesn't conduct electricity.</i>
8	B	Tech Basics	<i>The HF band is defined as 3MHz to 30MHz.</i>
9	C	Tech Basics	<i>Digital signals are defined as a stream of finite values.</i>
10	D	Transmitters	<i>The Modulation process in a transmitter mixes the audio signal with the radio frequency.</i>
11	A	Transmitters	<i>Refer to the Transmitter block diagram. The RF Amplifier connects to the antenna.</i>
12	C	Receivers	<i>The Detector (or demodulator) extracts the original audio signal from the carrier.</i>
13	B	Feeder	<i>Twin feeder (or ladder line) is balanced. Coaxial cable is unbalanced.</i>
14	A	Antennas	<i>Effective Radiated Power (ERP) is the power fed to an antenna multiplied by the antenna gain.</i>
15	D	Feeder	<i>A PL259 plug is designed for coaxial feeder.</i>

16	B	Propagation	<i>The Ionosphere is a layer of conductive gases between 70-400km that allows HF propagation.</i>
17	A	Propagation	<i>Snow, ice and heavy rain can reduce the range of UHF radio signals.</i>
18	A	EMC	<i>Immunity is a device's ability to work in the presence of strong radio frequency fields.</i>
19	D	EMC	<i>The filter is fitted close to the affected equipment to reduce interference from other sources.</i>
20	A	EMC	<i>The RSGB provides free leaflets and advice on handling interference.</i>
21	C	Operating	<i>UTC is used around the world so that logs of transmissions match up, regardless of local time.</i>
22	C	Operating	<i>You'll find the answer in the 2m band plan on page 3 of the 4-page exam booklet.</i>
23	D	Operating	<i>Setting the microphone gain correctly reduces the risk of poor audio and interference to adjacent frequencies.</i>
24	B	Safety	<i>Fuses contain a piece of metal that melts when the current is high, breaking the circuit.</i>
25	C	Safety	<i>Swarf is sharp bits of metal created whilst drilling, so eye protection is needed.</i>
26	A	Safety	<i>There is a risk of lightning with high antennas.</i>

The pass mark for the Foundation exam is 19 out of 26

You'll find more mock tests on the HamTrain website:
www.hamtrain.co.uk

Appendix C: Resource Hub

A quick reference to all the online resources mentioned in this guide.

HamTrain Course & Resources

- **HamTrain Foundation Online course** – www.hamtrain.co.uk
- **Course videos** – www.sxham.uk/trainvids

Exam Links

- **4-page exam booklet (EX307)** – www.sxham.uk/ex307
- **Book your exam** - www.sxham.uk/bookexam
- **Find your local RSGB club** - www.sxham.uk/rsgbclubs
- **Contact RSGB** - www.sxham.uk/rsgbcon
- **Need extra help?** www.sxham.uk/examhelp

Licensing & Callsigns

- **Ofcom Amateur Radio** – www.sxham.uk/ofcomar
- **M7 callsign availability** – www.sxham.uk/m7check

EMF & Safety

- **EMF Calculator & Guidance** – www.sxham.uk/emf

Exam Prep

- **Exam Hints & Tips (video)** – www.sxham.uk/trainvids
- **Quick revision material** – www.sxham.uk/revise
- **HamTrain Exam FAQ** – www.sxham.uk/faq
- **Report a problem exam question** – www.sxham.uk/report
- **Mock Tests** – www.sxham.uk/mocks & www.sxham.uk/mockbook

Organisations

- **Essex Ham** – www.essexham.co.uk
- **HamHub UK** – www.hamhub.uk
- **Ofcom** – www.sxham.uk/ofcomar
- **Join RSGB** – www.sxham.uk/joinrsgb

About The Author

Pete Sipple (callsign M0PSX) obtained his amateur radio licence in 2010, following a lifelong interest in radio. After being a member of various traditional amateur radio clubs, Pete decided to form an online community, Essex Ham. This group aimed to help promote amateur radio, raise awareness for the hobby and provide a useful online resource.



Pete formerly worked in the broadcast radio industry as a producer and engineer. He later developed an interest in mobile comms, becoming a software project manager, as well as a part-time college lecturer.

Following his interest in furthering amateur radio, Pete launched training courses at clubs in Essex, developing award-winning training material. Creating an online training course seemed an obvious next step, hence the creation of the Foundation Online course that has now helped thousands of new amateurs to get started in the hobby.

Our thanks:

Thanks to the following people who have supported us over the years, especially those who have helped us with training initiatives in recent years, with special thanks to:

- Andrew M0ONH
- Andrew M0OTV
- Dorothy M0LMR
- Kelly M6KFA
- Paul G7BHE
(www.prepcomms.uk)
- Richard G7OED
- Sarah M6PSK
- Trevor M5AKA

Our thanks also to the team of volunteer exam invigilators across the UK, without whom we'd have no online exams.

And Finally...

We hope you have found this guide useful and that it helps with your studies.

If you have any feedback about this guide, please do let us know, so that we can continue to make improvements and updates. You can send your feedback to bookfeedback@essexham.co.uk

You can find information about updates to the Foundation Study Guide at shortlink: **www.sxham.uk/fsg**

If you found this study guide useful, please take a few minutes of your time to rate the Foundation Study Guide on the Amazon website, as this will help others to discover this guide.



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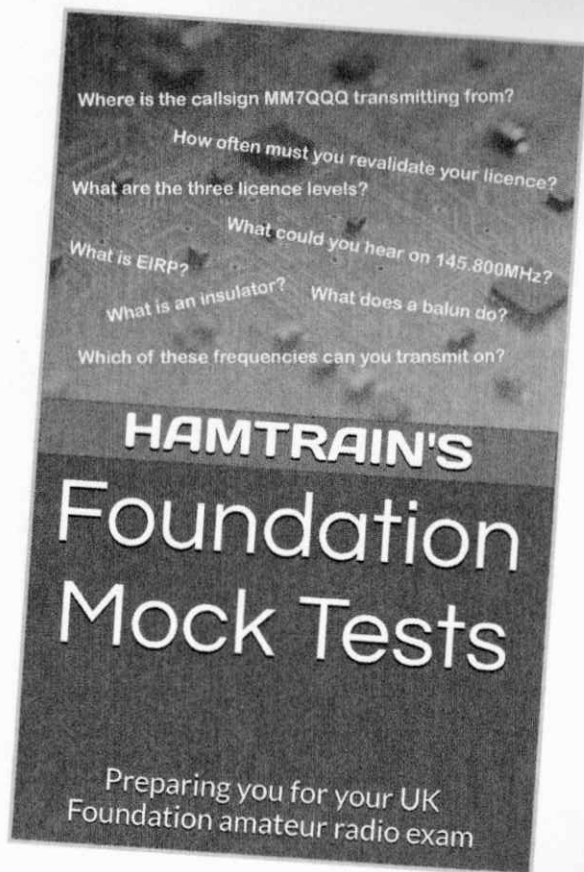
If you're looking to find out more about the hobby, please do check out the Essex Ham website, where you can also sign up for free as a member of one of the UK's largest online communities – you don't have to be from Essex to join.

You can also sign up for our newsletter for updates on amateur radio. We're also part of HamHub UK, a growing nationwide community of radio amateurs.

Links:

- **Essex Ham:** www.essexham.co.uk
- **HamTrain / Foundation Online:** www.hamtrain.co.uk
- **HamHub UK:** www.hamhub.uk
- **Essex Ham Discord Server:** www.sxham.uk/discord

Also from HamTrain:



A book of six complete mock tests to test whether or not you are ready for the Foundation exam.

Foundation Mock Tests is available as an eBook or in paperback

www.sxham.uk/mockbook

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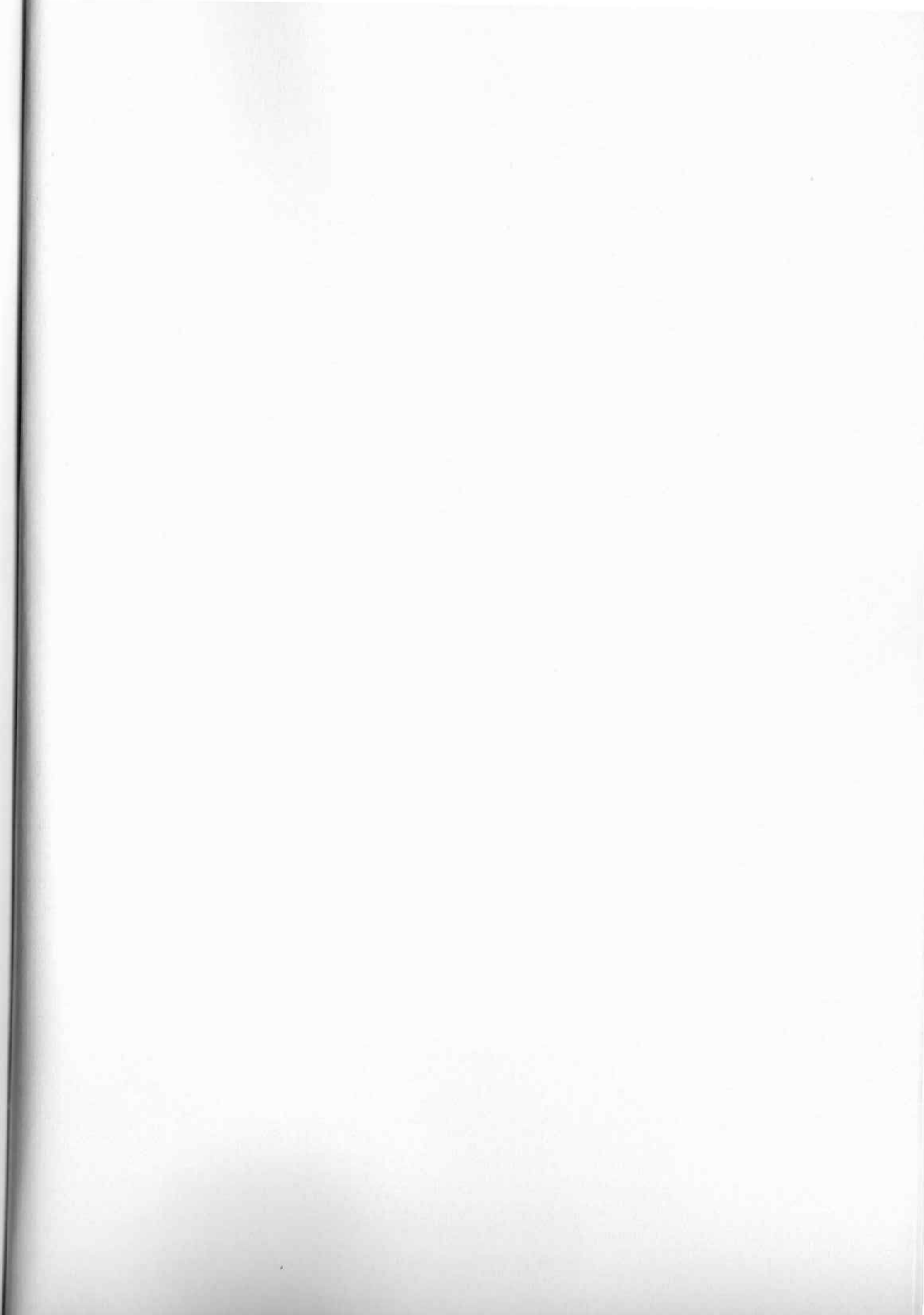
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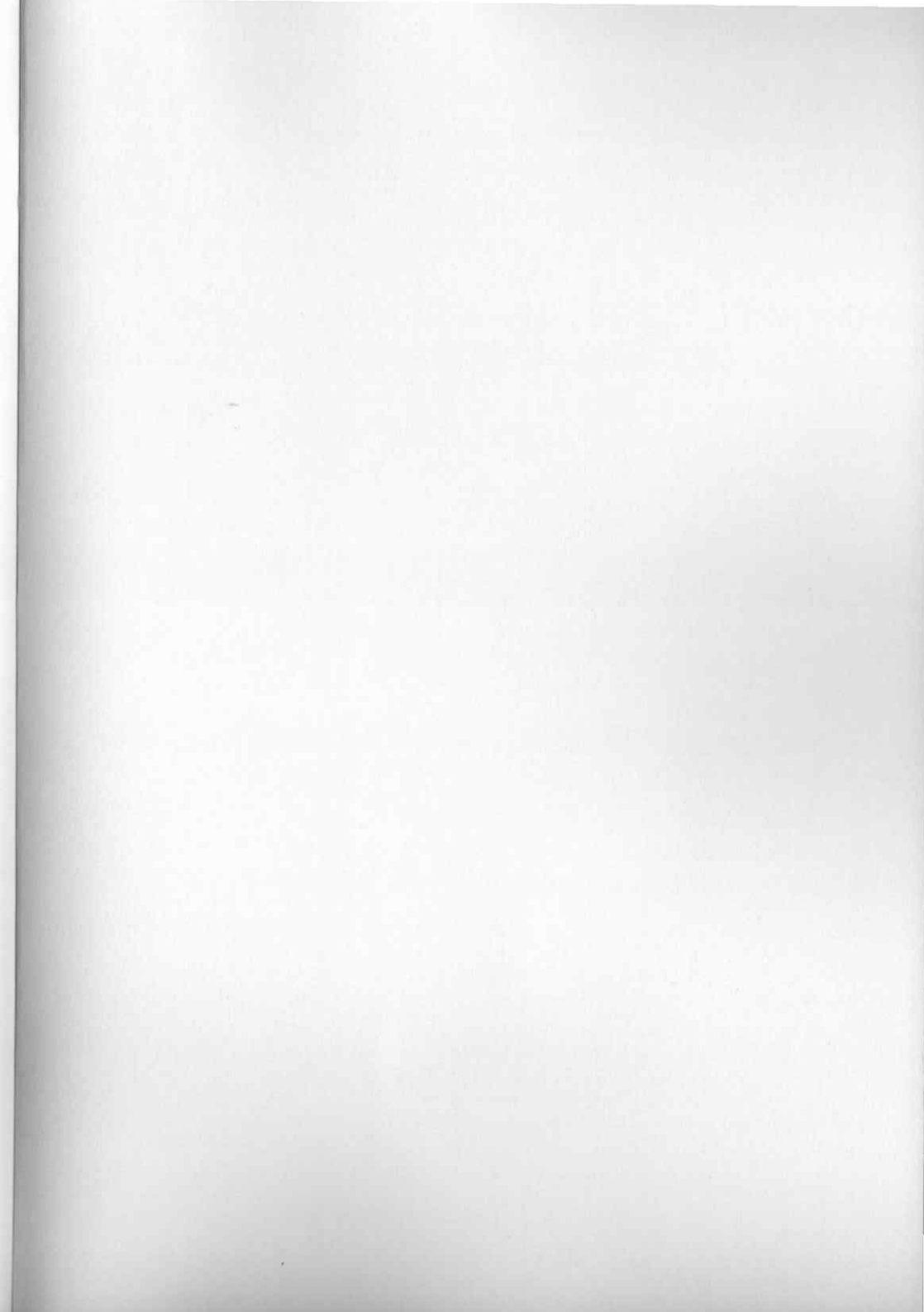
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Getting your amateur radio licence is now easier than ever before. You can now take the UK's Foundation amateur radio exam online from home, without the need to travel to a local exam centre. Once you pass the multiple-choice Foundation exam, you'll get your first licence and callsign, and you're on your way to exploring the world of amateur radio.

This book is designed as a simple revision guide, and if you're looking to pass the UK amateur radio Foundation exam, this guide covers all that you'll need know. It includes a summary of the exam topics, helpful tips on how to tackle the exam, a glossary of common terms, and a mock exam to see if you're ready to pass the Foundation exam.

Essex Ham's "HamTrain" team has been helping students prepare for the UK Foundation exam since 2015.

Our Foundation Online course has helped over 14,000 students to get started, and our course material is in use at clubs across the UK.

This book can be used as a stand-alone revision guide, or as part of HamTrain's online course. This guide has been updated for the RSGB's Foundation exam syllabus v1.6b, and is suitable for exams from April 2025.

